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ABSTRACT

Presented are 13 papers describing the Seattle Project and reviewing the literature relevant to the project's purpose of developing and testing an assessment format to enable nurses to better identify health and developmental problems in children. Six papers pertaining to predictor variables cover the areas of prenatal and perinatal factors, congenital abnormalities, nutrition, parents' perceptions of their children, the animate environment, and the inanimate environment. Considered in the six papers on outcome variables as assessments of the child's functioning are physical growth and development, sleep patterns, childhood accidents, language, mental development, and social development. Tables and figures are also provided. (SB)

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Child HEALTH ASSESSMENT

Part 1 : A Literature Review

EC073752

Child HEALTH ASSESSMENT

Part 1 : A Literature Review

Kathryn E. Barnard, R.N., Ph.D.
Helen Bee Douglas, Ph.D.
Editors

December 1974

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Foreword

The Division of Nursing supports many activities to increase the scientific base of nursing practice in working toward its goal of improving the quality of health care for all. Assessment of health status is one of the most important functions of nurses, and this function is especially dependent upon a sound accumulation of research evidence that can provide guidelines for nurses in making decisions regarding appropriate nursing intervention and comprehensive health care.

Nurses traditionally have had responsibility for assessing the health and developmental status of young children, but they have been hampered by the lack of reliable assessment tools and by the dearth of prospective evidence to assist them in planning, providing, and evaluating care.

In 1971 the Division negotiated a contract with the University of Washington to develop and test an assessment format that would enable nurses to identify and care for existing health and developmental problems in children and that would assist them to define groups who are at high risk of physical, emotional, educational, and social dysfunction in order to provide effective preventive and health promotive care.

The first step required in undertaking this project was an integrative review of pertinent literature from various fields. This volume contains the results of the extensive analytical review made by the project staff under the direction of Dr. Kathryn Barnard, Director. The papers compiled here not only provide a framework for this clinical nursing research but will also be useful to other investigators with related concerns. Hopefully the review will stimulate additional efforts, and help in delineating questions for further study of the processes affecting child health and development and thus, through increased knowledge, be instrumental in expanding nursing expertise in the field of family and health care.

Jessie M. Scott

Assistant Surgeon General
Director
Division of Nursing

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Planning an assessment methodology which incorporated the relevant features of a young child's physical health, development, behavior and environment was a complex and demanding task. It was accomplished with the strong support and commitment for the cause by many persons. We would like to acknowledge those whose assistance we found especially noteworthy; this includes staff from the Division of Nursing, and other consultants, technical staff, and students.

Consultants representing a variety of disciplines were called upon; their advice molded the direction of the literature review and the subsequent design for testing assessment procedures. The consultants were:

Dr. Richard Bell, developmental psychology; Dr. T. Berry Brazelton, pediatric medicine; Dr. Bettye M. Caldwell, developmental psychology; Dr. Helen Bee Douglas, developmental psychology; Dr. Mildred Disbrow, sociology and nursing; Dr. Sandra J. Eyres, epidemiology and nursing; Dr. Setsu Furuno, psychology and public health; Dr. Madeleine Leininger, anthropology and nursing; Dr. Clifford Lunneborg, experimental design; Dr. Mary V. Neal, nursing; Dr. Evelyn Thoman, developmental psychology; Dr. Waldemar Wenner, pediatric medicine; and Dr. Elizabeth Hagen, evaluation and measurement.

In addition to contributing authors of this volume, the following people have assisted in reviewing literature and carrying out the project: Barbara Clark, Sally Faustino, Jayne Jackson, Rebecca King, Hazel Kim, Phyllis Leonard, Emily Marks, Sandra Mitchell, Janice Moser, Calista Mosher, Susan Malody, Kathleen Quinn, Louise Ryan, and Jane Schwartz. Special acknowledgment goes to Harriet Carroll at the Division of Nursing for her editorial assistance.

Finally, a large tribute goes to Ethel Hamlet and Vivian Camandona whose secretarial skills made this material available for all.

KATHRYN E. BARNARD
HELEN BEE DOUGLAS

Contents

Page

Foreword iii
Acknowledgments iv
Tables and Figures vi
The Seattle Study: An Overview 1
Kathryn E. Barnard, R.N., Ph.D.
Helen Bee Douglas, Ph.D.
Sandra J. Eyres, R.N., Ph.D.

PREDICTOR VARIABLES

Prenatal and Perinatal Factors 25
Bernice S. Collar, R.N., M.Ed.
Congenital Abnormalities 37
Constance Macdonald, M.D.
Nutrition 59
Moira Bassetti, Ph.D.
Parents' Perceptions of Their Children 79
Anita L. Lendzion, R.N., M.S.N.
The Animate Environment 87
Anita L. Lendzion, R.N., M.S.N.
The Inanimate Environment 103
Helen Bee Douglas, Ph.D.
Charlene Snyder, R.N., M.S.N.

OUTCOME VARIABLES: ASSESSMENTS OF THE CHILD'S FUNCTIONING

Physical Growth and Development 115
Joan C. Bouchard, R.N., M.S.N.
Sleep Patterns 137
Kathryn E. Barnard, R.N., Ph.D.
Childhood Accidents 149
Joan C. Bouchard, R.N., M.S.N.
Language 161
Mary H. Abbs, Ph.D.
Mental Development 179
Helen Bee Douglas, Ph.D.
Beverly VanderVeer, Ph.D.
Social Development 197
Beverly VanderVeer, Ph.D.

Tables

		Page
1.	Naive model of prediction of ill health	6
2.	Semi-naive model: A second try	7
3.	Variables and sources of data	17
4.	Summary of findings of prospective studies—relationship between perinatal complications and outcome in early childhood	30
5.	Number and percent of infants with congenital malformations among those weighing more than 500 grams at birth, by outcome of delivery	39
6.	Fatalities from leading types of accidents in the United States, classified by age and sex, 1967	150
7.	Type of accident resulting in medically attended injuries—annual rates per 1,000 children for all injuries and for severe injuries, and three measures of severity for each type of accident	153
8.	Estimates of prevalence and incidence of oral language disabilities by type (ages 4–17)	166
9.	SILD items, receptive scale	173
10.	SILD items, expressive scale	173

Figures

		Page
1.	Prediction model three	9
2.	A generalized restatement of model three	11
3.	Health care model	15
4.	Head circumference	48
5.	Minor anomalies of the eyes	49
6.	Inner canthal and outer orbital distances	50
7.	Minor anomalies of the ears	51
8.	Minor anomalies of the mouth	52
9.	Minor anomalies of the hands	53
10.	Minor anomalies of the foot	54
11.	Anthropometric chart	126
12.	Chart of newborn classification and neonatal mortality risk	129
13.	Whitten's theory of growth failure	133
14.	The longest daily sleep period during the first 2 years of life, including two standard deviations	141
15.	The daily total sleeping time during the first 2 years of life for infants in this study, including two standard deviations	141

The Seattle Study: An Overview

The ultimate goal of the project reported here is to develop methods to identify children in adverse situations so that preventive services can be offered at a time when habilitation or remediation is most influential in promoting optimal health. This work was initiated and supported by the Division of Nursing to determine what aspects of the young child's health are relevant to this goal and how and when they should be assessed. The fundamental intent is to enable nurses and paraprofessional health care personnel to assume more responsibility for first level screening and primary care of infants and young children, to identify those requiring further attention and, when appropriate, to refer children to the agency or individual that will provide more specialized diagnosis or therapy.

The literature reviews included in this volume represent a first step in evaluating pertinent areas of knowledge and their potential contribution to assessing child health.

The Complexities of Assessing and Predicting Child Health and Development

At the outset, the task appeared to be a fairly straightforward one. A careful analysis of the literature was an essential starting point to determine what tests and measures had already been developed to identify high-risk infants and to predict later health outcomes.

Following this, the plan was to determine how nurses and paraprofessionals could be prepared to use the tests and measures in assessing child health and development in a reliable and valid manner. The authors soon learned that this undertaking was much more complicated and challenging than originally anticipated. Basic questions needed to be dealt with, differing viewpoints of authorities had to be weighed and conflicts resolved. For example:

1. How does one define a "high-risk" infant? What behaviors in a 2-year-old, a 7-year-old, or in an adult, are considered "nonhealthy" and therefore worthy of concern? By far the most common outcome variable studied in research on high-risk infants is intellectual functioning, usually measured

by an intelligence test. Physical status, such as presence of disease, or signs of non-normal development are also favorite variables. Other variables, such as interpersonal behavior, emotional development, and language development are less often studied, perhaps because only poor measures of them are available. However, these aspects of child functioning are of major importance in developmental assessments and in planning appropriate intervention, i.e., determining what is needed and what can be done to help, either by working with parents directly or in obtaining other types of therapeutic assistance.

All the child's characteristics—physical, emotional and intellectual—interact in complex ways, so that a dysfunction or failure in one area will have implications for all the others. Review of the literature on nutrition, for instance, points out that nutritional status is difficult to isolate as a single variable, partly because it interacts with so many other health states. Studies of congenital abnormalities show relationships between physical characteristics and disturbed child behavior. And multiple health and health related factors have been shown to influence physical growth and development of the child. These relationships are discussed in detail under their specific headings. Inferences to be drawn from them, separately and in combination, are important for any comprehensive study of child assessment. Essentially they document the need for predicting multiple types of health and developmental outcomes or, as we prefer to call it, "ill health." Those outcomes such as mental development and physical status which have been used to identify problem groups in the past must be included in the definition, but those such as responsiveness to the social environment and functional behavior, which are more elusive, must also be part of the definition of children with ill health so that the pertinent risk factors can be studied.

2. Having once adopted a fairly broad definition of health and ill health, and having committed ourselves to a search for antecedents or predictors of the several kinds of ill health, we were faced with the fact that the research evidence on predictors and antecedents is very uneven—both in coverage and in quality. This is true for even some of our most prevalent childhood problems, as described in our review of the literature on accidents (chapter 9).

More is known about the prediction of cognitive dysfunc-

tion based on physical characteristics than almost any other variable. For example, Smith, Flick, Ferriss, and Sellmann (1972) report that babies born after a difficult labor, or with complications of labor, or those with a low 5-minute Apgar score are more likely to have low IQ scores at age 7 than are infants without such prenatal and perinatal complications. This knowledge is extremely useful, since it tells us that measurements of prenatal and perinatal conditions will be important in any predictive system. But this knowledge alone is frustratingly incomplete.

What about the external environment? Does it matter too? In the above study, there are clear signs that it does. There maternal education was included as a predictor variable, and it turned out to be the best of all predictors of cognitive function studied. But maternal education is not the direct cause of intellectual functioning in a child at age 7. We have seen, for example, that the behavior of a mother with little education and the environment she provides differ from the behavior and environment of a mother with more education, and these behavioral-environmental differences may be the key determinants of the child's cognitive development. (See chapters 5, 6, and 11.)

The study by Smith, Flick, Ferriss and Sellmann, and others like it, don't tell us what to look for in the environment. Similarly, the experimental studies tend not to describe outcome variables other than intellectual status. Does gestational age predict emotional development as well as intellectual development? Does maternal age predict language development as well as cognitive development? Unfortunately, there is no single study that answers these questions. What exists instead is an assortment of small studies, each addressing a single piece of the complex puzzle, but neither singly nor collectively giving a clear answer to the questions with which we began, namely: what do we have to measure in an infant or young child in order to predict his risk of later negative outcomes, and what kind of health and developmental outcomes do the various measures predict?

3. The major gap in the puzzle is in the area of environmental contributions to risk. Literature on the impact of early physical variables (such as prematurity, or low Apgar, or malnutrition) is not perfect, but it is at least adequate. As discussed in chapter 1, evidence regarding prenatal and

perinatal factors, though scanty, is reasonably consistent, and one can extract from this evidence a fairly well agreed upon list of the important variables to measure and some of the outcomes they predict. But in the area of environmental factors, we are really still in the groping stage. Here there are two related problems: (a) defining the important dimensions of the environment which ought to be measured, and (b) measuring them.

The available evidence suggests that the following environmental variables are probably of major importance for the child's healthy growth and development:

a. the amount of inanimate stimulation available to the child, e.g., the number and variety of toys or the variety of experiences provided (Yarrow et al., 1972);
b. the amount of animate stimulation, e.g., the amount of time the child is talked to, held, cuddled, etc. (Yarrow et al., 1972);
c. the manner in which the animate stimulation is provided, whether "contingent," i.e., depending on something the child does or "non-contingent," i.e., given irrespective of what the child does (Lewis and Goldberg, 1969);
d. the style of teaching used by the significant adults in the child's life. Some teaching styles, for example, seem well designed not only to teach a child new skills but also to teach him how to learn on his own. Other styles do not encompass this characteristic. (See Streissguth and Bee, 1972, for a review);
e. the mother's (or other adult's) perception of the child, e.g., whether she sees him/her as normal, supernormal, subnormal, whether she likes the child, and how she performs her role as mother (Broussard and Hortner, 1971);
f. the amount of stress in the family situation (Wyler, Masuda, and Holmes, 1971);
g. the general emotional stability of the mother and family members;
h. the presence of a father or some other male figure in the home. This seems to be particularly important for boys, especially in their early years (See Hetherington and Deur, 1972, for a review).

There are research findings on each of these variables which suggest some of the kinds of health outcomes that may

result. But there are no good longitudinal studies—short-term or long-term—which include all of the above variables and which use a broad spectrum of outcome variables to assess the impact on the child. A recent study by Yarrow et al. (1972) comes closer than most, but this is a concurrent study, not a longitudinal one, so we cannot know the prospective outcomes for the children.

For many of the environmental variables listed, no good measures presently exist. Yarrow and his collaborators, in order to assess animate and inanimate stimulations in the home, spent over 6 hours observing in each home. Such a measurement procedure is not feasible for any kind of widely used system of assessment and diagnosis, so the problem is to discover a way to measure the same thing with less investment of time. Clearly much developmental work needs to be done in this area before we will have some of the pieces of the puzzle available to us. The challenging nature of such an undertaking becomes evident upon realizing the problems of measurement and prediction still existing for the most frequently used child assessments as described in the chapter on mental development. However, until we know more about the environmental processes influencing the child, the optimum methods for assessing antecedents of child growth and development and for directing nursing and other therapy will continue to be elusive. In addition, little attention has been given to how infants' behaviors might influence what happens in their environment. As reviewed in the chapters on social development and animate environment, there is evidence that the child does help to create his milieu through reciprocal responsive behavior with his parents.

4. Variables don't sort themselves out neatly into the categories of "predictor" and "outcome," even though we have spoken thus far as if they did and organized our reviews around those designations. In fact, the child's characteristics at birth and others which appear as he develops, are predictor variables as well as outcomes. A 2-month-old child may have erratic sleep schedules because he was premature or because his mother is unstable and unable to assist him in developing stable schedules, or for a host of other reasons. But the fact of the erratic sleep schedule affects the way in which all the people around the infant react to him. The process is an interactive one, not a unidirectional one, which infinitely complicates the problem of prediction.

5. Finally, the task is complicated because the model of prediction we have finally arrived at is necessarily complex. We began with an essentially naive model of prediction, thinking the world would arrange itself something like table 1.

Table 1.—Naive model of prediction of ill health

Variables which independently predict indicated outcomes	Types of ill health (outcomes)
Prematurity Low Apgar at 5 minutes Low maternal education Malnutrition Maternal teaching style, etc.	Low IQ. or retarded intellectual development on other measures
Malnutrition Poor sleep state organization at 3 months Prematurity Prenatal or perinatal complications, etc.	Physical ill health: e.g., positive neurological signs, high disease rate, low height and weight, etc.
Slowed maturation because of malnutrition Amount of conversation between mother and child, etc.	Language retardation

There are still some ways in which this is a good model; it's not a bad starting point, at any rate, since making the effort to fill in such a table gives one some idea of the gaps in the literature. But it won't work in the long run for several reasons. First, such a model ignores interaction effects. To take only one example: one of the common generalizations, reflected in the entries in table 1, is that prematurity is associated with lowered cognitive functioning at a later date. And it's true as a gross generalization but, on closer examination, it turns out to be true only for children reared in low-income families. In general, a noncomplicated premature baby raised in a middle-income or high-income family does fine; he is not a high risk of later intellectual difficulties (Drillien, 1964). The same sort of thing, on a more general scale, was found by Willerman and his associates (1970): children who were low in "intellectual functioning" as assessed during the first year of life had a very poor prognosis for later normal cognitive functioning only if they were from low-income families. The children with the same early low scores were normal or better in later assessments if they had been raised in higher income families. Unless we have a model which

takes into account the possibility of such interaction effects, we will wind up, among other things, diagnosing a great many more children as being at high risk of poor functioning than actually are.

A second major flaw in the "naive model" is that it doesn't take into account the fact that ill health breeds ill health. A child who is slow to develop language, for whatever reason, provides a different stimulus to the people around him than does a normally speaking child; he will have greater difficulty in school, may have reduced self-esteem, and may show withdrawal from peers. In such a case, unless we have a model that permits us to see that the language retardation is the key problem, we may recommend altogether inappropriate remedial action.

A reasonably logical next step in building a model, and one which may prove useful in the long run as a descriptive procedure, is given in table 2. All we've done here is to recognize the fact of interaction, the fact that ill health tends to come in clusters, and to try to relate the clusters to one another.

Table 2.—Semi-naive model: A second try

Predictor combinations	Ill health combinations
Insufficient linguistic stimulation; prematurity associated with low social class	Language retardation, intellectual retardation, poor self-concept
Poor teaching style but adequate linguistic stimulation; prematurity	Intellectual retardation *without* severe language retardation

The major drawback with this system is that it becomes unwieldy almost immediately. The number of possible combinations of ill health are almost endless, and a particular combination may have been brought about by any or all of a great many factors. A third way to go is to ask a different sort of question: what early variables predict any kind of later ill health? In the list produced in reply to this question would be all the prenatal and perinatal physical measures, and many of the environmental measures listed above. Such an approach would be useful for a very preliminary screening, done perhaps by a nurse, since any child who was high on any of the risk factors could be considered "at high risk," and sent on to some additional assessment or treatment. The drawbacks are obvious, however. Such an approach, like the first naive approach ignores the interaction effects and as a consequence would result in diagnosing far too many children as being at high risk and might miss some children

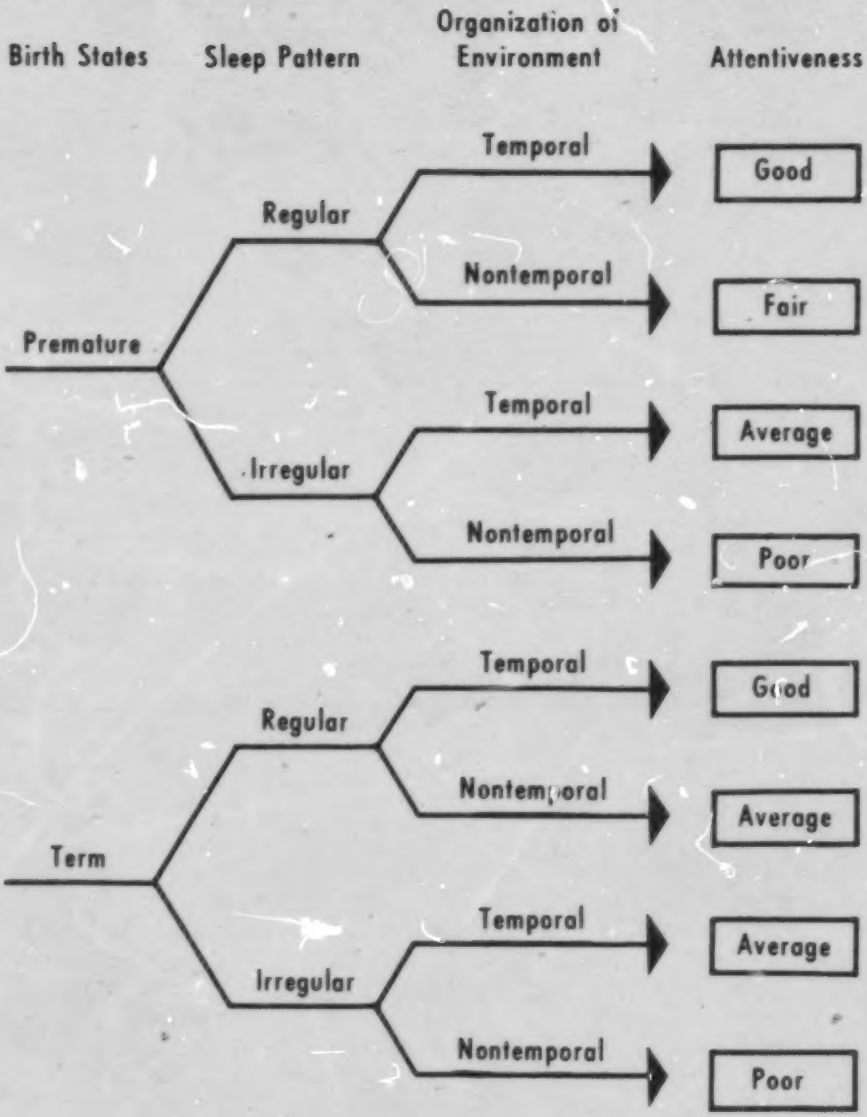
who were experiencing mild forms of potential risk factors in combination.

The most complex model, unfortunately, is probably closer to the truth. It is illustrated in figure 1.

The conditions in the model relate to the organization of sleep-wake behavior. We know that the premature infant because of his immaturity has less organization of sleep-wake at birth than does his full-term infant counterpart. How the infant's environment is set up to fit in, or shape his sleep-wake periods, will influence this innate organization. Furthermore, the capacity of attentiveness when awake could be influenced by the interaction of his biological organization of sleep-wake pattern and the environmental influences. For example, a premature infant with an irregular sleep pattern whose parents provide fairly regular routines and conditions to promote sleep at sleep periods will have a greater chance of having a good attention span than a child whose environment does not enhance the innate organization of sleep and wake.

Thus, model three suggests several interesting possibilities. First, negative influences may be cumulative, so that small amounts of a whole series of negative factors may produce as much ill health as a large dose of a single factor. Second, the model suggests that at each of several points in his life, the child may be "equipotential" for health or ill health. Let us use a seemingly far-fetched illustration to explain what is meant by this. Money (1971) has made a similar suggestion about the development of an individual child's gender identity, indicating that there are three crucial points at which the child is "bipotential" for female or male gender identity. The first point is at conception, when either an X or a Y chromosome is received from the sperm, thus determining the genetic sex. The second point is during the early weeks of gestation when an infusion of androgen results in the development of male genitalia while the absence of such an infusion results in female genitalia. The crucial part of this is that the hormonal effect occurs regardless of the genetic gender identity determined at conception, so that a genetic female, experiencing the infusion of androgen, will develop male genitalia. So, this second time point determines the hormonal sex identity. Money suggests that after birth, during the early years, there is a third time period during which the child can go either way. We might call this "psychological gender identity," since the evidence suggests that it is the sex perception conveyed to the child as he is reared that determines his sense of sexual identity.

Figure 1.—Prediction model three

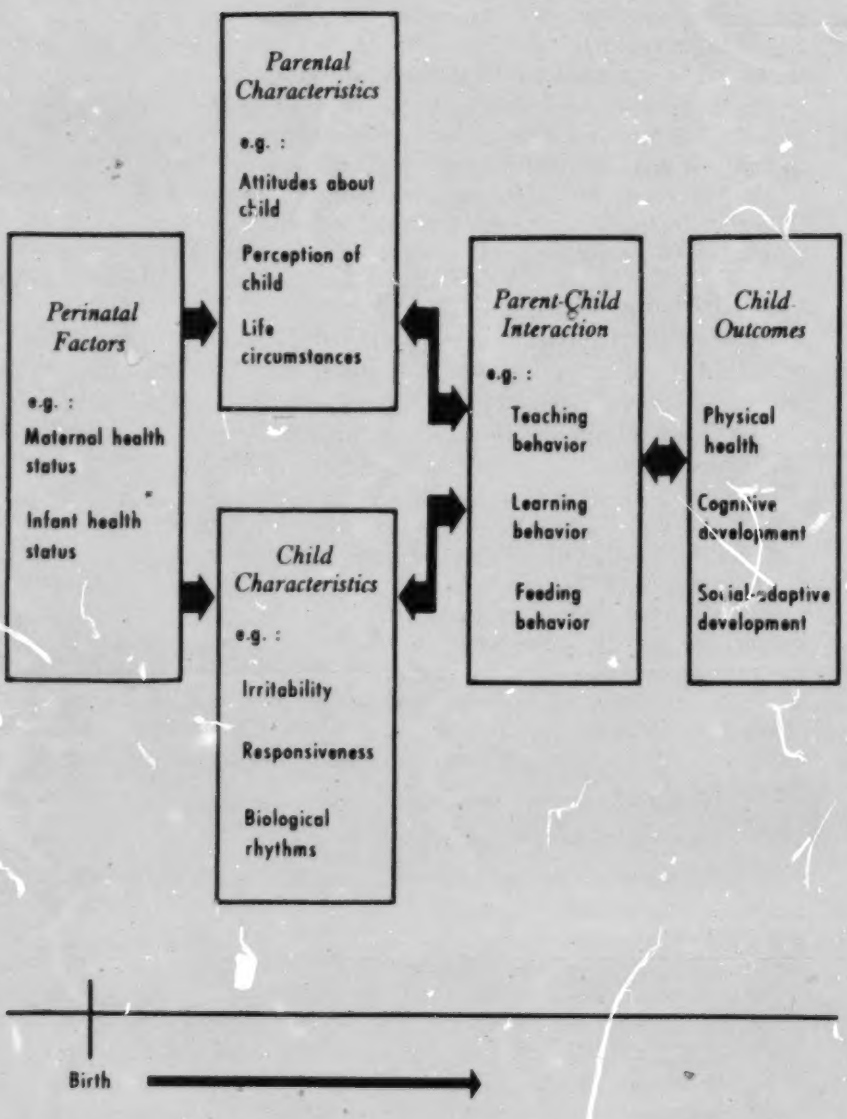


Our model three at least raises the possibility of similar kinds of "critical points or periods" during the child's lifetime, with each period possibly superceding the one before. Such a model puts greater emphasis on environmental events than has been customary in the past, since the implication is that a poor environment can "ruin" a good baby, while a good environment can "save" a poor baby. Certainly the evidence concerning the prognosis for prematures is consistent with such a view, but not all other instances may be. For example, the effects of dietary deficiency may become permanent at some specified point, after which improvement in diet will make no helpful changes.

A generalized restatement of model three is presented in figure 2. It is complex, yet we believe that eventually all the points and combinations in such a model must be available for measurement if we are to make good predictions about any of the several kinds of ill health. To fill in the chart, studies are required which follow children of various initial characteristics through the early years in order to determine the sequential impact of different kinds of early and later experiences. The question then becomes not "is prematurity bad for a child?" or "what does a low Apgar predict?" or "what is the outcome of insufficient inanimate stimulation?" but rather, "under what combination of circumstances does prematurity predict poor outcome?"; "in which children does a low Apgar signal later difficulty?"; and "under what conditions do low levels of inanimate stimulation have a negative effect?"

The conceptual framework presented in figure 2 has guided our project activities. Under this model the types of variables which are believed to interact over time to influence child outcomes are (1) the perinatal factors, those physical characteristics of the infant that are present at birth, or those health status events that are present during pregnancy or result from the birth process, which provide a background against which the infant begins extrauterine growth and development; (2) the characteristics of the parents and child which help to constitute the environment and its stimuli within which the child develops; and (3) the parent-child personal interaction, the reciprocal behavior which stimulates development and promotes health. Certain relationships between the variables are of particular concern conceptually as they may represent options for nursing intervention to optimize child health and developmental outcomes. For example, by understanding the parental perceptions of the child's potential for development, the nurse may be able to change the parents' behavioral interaction with the child so as to increase the stimulation toward development. This and similar assump-

Figure 2.—A generalized restatement of model three



tions can, of course, only be determined later by testing the various hypotheses which this conceptual framework generates. At this point in time, attention must be directed to the more preliminary work.

The Seattle Study was planned as a first trial of assessment methods to operationalize the conceptual framework presented in figure 2, and as a test of the ability of the assessments to predict *childhood health and developmental problems.*

The literature review and consultation with other investigators helped to determine what types of observational methods, questionnaires, and interviews might be both important and feasible in the screening and identification of high risk children. More importantly, this preparatory work led to insights and convictions which helped shape the study design and focus the project intent.

Child Rearing

Put simply, our present view is that parents need to know how to go about child rearing, and they need to be free to interact appropriately with their child. At times parents are so influenced by the stress of their own life situation that they are not able to incorporate their knowledge into action.

It is our opinion that effective screening methods need to be established which are sensitive to this view of child rearing, i.e., parental knowledge of children and the capacity to interact in a positive manner. Therefore, in addition to the physical and developmental issues typically observed and assessed, information will be gathered about the parents' perceptions of their children, the interaction between parents and children, and other factors in the parents' life situation which demand their energy and attention. If our formulation of effective child rearing is correct, these variables will contribute to later differences found in child health outcomes.

Parents as Assessors

Parents have been shown to quite accurately assess their child's problems. These observations in regard to intellectual functioning are reviewed in the chapter Parents' Perceptions of Their Children. Parent reporting is a logical step in child assessment because of the living proximity which makes mothers and fathers the most frequent observers of their children's behavior. It also assumes importance because, if parents define health status or behavior as a problem, this perception can influence interactions in the home and the subsequent well-being of family members.

An example of defining problems of this nature by parental report is discussed in the chapter Sleep Patterns.

These factors suggest the value of including a parental evaluation of children as an extension of health personnel evaluations when screening for health and developmental problems.

Assessment in the Real World

Since the guiding purpose of this project is the development of screening and assessment methods which can be applied to benefit children, the development of these methods would serve little purpose unless they are actually used by health care personnel. The probability of their application is greatly enhanced if they are devised in accord with the realities of the health care system. For this reason several criteria for the assessment format have been adopted: (1) it should complement current practice; (2) it should be logical and feasible to apply in terms of personnel roles; and (3) its components and techniques should be compatible with the optimum use of scarce resources.

When considering the most prevalent problems in child health and development, those problems to which nursing could make the strongest contribution, and those conditions of children and concerns of parents which tend to be neglected currently in the health care system, it became clear that emphasis needed to be given in this project to child rearing and nurturing as a focus for nurse screening and intervention. It also became clear that certain health outcomes are routinely identified and handled in existing health care systems by personnel, such as pediatricians, at the newborn period. Rather than replicating these efforts the information they normally provide might more profitably be used by others such as nurses to supplement their understanding and identification of children's problems and to develop their role in planning an effective care regimen for the more neglected areas of child care.

In order to proceed with the development of a useful screening format, it became necessary to specify the health care model in which such a process could be operational in the real world. The model shown in figure 3 was developed considering: the need to make the best use of lesser trained health personnel; the risk factors, which have already been studied, that allow certain target groups or high-risk populations of children to be delineated; the time-consuming nature of more definitive screening and testing; and the greater expertise required for more complex assessment and diagnosis. The various stages shown in the health care model

do not represent departures from existing systems; they are compatible with today's trends in health care.

The study was planned to further delineate Stages I and II shown in figure 3. It is the eventual intent to learn (a) what identifying risk factors best define the target groups in Stage I, which could be done by informally trained personnel; and (b) what finer assessments done by nurses in Stage II could lead to their appropriate intervention or referral to "experts" in Stage III.

While examining existing assessment and measurement methods, the health care model in figure 3 was kept in mind. This led to our choosing a relatively simple method and a more complex one when several methods were available for a particular dimension. These methods will be evaluated for their comparative predictive value with the intent of always choosing the least time-consuming method requiring the least expertise possible.

The Purpose of the Study

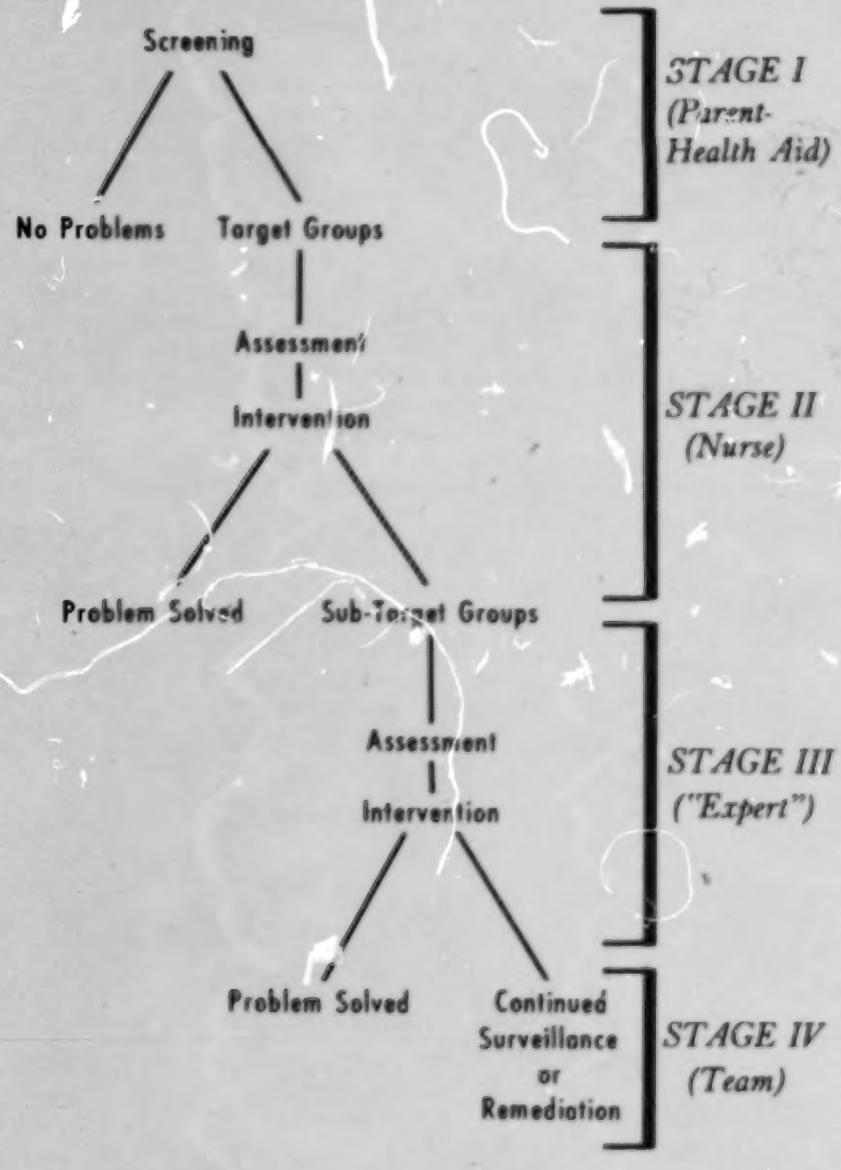
The first trial of the assessment methods was planned to obtain preliminary answers to two basic questions:

1. What factors are related to child health and development problems and are therefore candidates for inclusion in screening for high-risk children?
2. How can these factors best be measured operationally in a feasible screening process?

Finding answers to the first question as a part of this project was necessitated by the gaps in existing information. It is possible to devise an efficient screening process for preventive care only if the characteristics of children who will have health and developmental problems at some later point can be identified.

Because previous efforts at documenting infant risk factors have tended to focus on a few variables, usually demographic, biological or overtly pathological in nature, little is known about how much additional variability in outcomes is produced by other social, environmental, and behavioral variables. In order to know whether the latter hold a feasible potential for adding discriminating power in screening and are potential targets for intervention, they must be considered simultaneously with the former characteristics. This leads to an admittedly lengthy list of study variables. But to consider only selected types of variables for their relationship to child health and development, even in early phases, would be to perpetuate existing gaps in information and lead to inefficiency in ruling out early those screening factors which are redundant and thus unprofitable for further attention.

Figure 3.—Health care model



Several steps will be taken to determine the quality, feasibility and usefulness of the assessment methods and variables. The results of this instrument pretest phase will provide evidence for dropping certain factors from the format and for choosing some methods over others.

In addition to testing for the attribute of predictability, the items will be examined for redundancy through correlation techniques. The amount of discrimination for the least administration time, and the training time required to reach acceptable levels of interobserver reliability will also be used to determine whether methods should be retained.

This will be an important first test of the instruments devised to assess environmental characteristics such as mother-infant interaction. Construct validity will be evaluated through correlations with the other study variables. Some of the items in the mother interviews are asked in several forms or in an open-ended manner, so that classification can be established and the best method of eliciting answers determined.

The Study Assessment Variables and Methods

The literature review and the developmental phase was used to specify the factors which needed to be assessed in a screening format. It was also used to decide how to operationally measure those factors through an evaluation of existing methods.

Standard definitions and measures are available for some of the variables, especially for those which have received the most research attention. For some variables, however, no satisfactory assessment instruments were found. This was particularly true for the aspects of the parent-child interaction and the family social environment thought to influence child health and development. Observational methods and questionnaires have been devised to fill these gaps. Instruments in various stages of refinement were chosen for further testing as to their usefulness in the desired screening process.

The variables and their operational measures chosen to be further explored in the study are shown in table 3 in this order: (a) the child health and developmental outcomes, (b) the known perinatal risk factors, and (c) the mediating characteristics of parents, infants, and environments.

The first set of variables, the 12-month outcomes, will be used as the dependent variables in predictive and discriminant analysis. These serve to define the health and developmental problems for which the screening format for high-risk children is being devised.

Table 3.—Variables and sources of data

Variable	Data source
Child Health and Development Outcomes	
CHILD'S PHYSICAL HEALTH	
Physiological and structural intactness	Physician's exam at 12 months[1]
Growth: height, weight, occipital frontal circumference	Physician's exam at 12 months[1]
Nutrition: hematocrit	Physician's exam at 12 months[1]
Accidents: number during first year	Mother's report
Morbidity: number of illnesses during first year	Mother's report and medical record[1]
MOTOR AND MENTAL DEVELOPMENT	
Motor development	Bayley Mental and Motor Scales and Uzgiris-Hunt Developmental Scale by psychologist at 12 months
Mental development	Bayley Mental and Motor Scales and Uzgiris-Hunt Developmental Scale by psychologist at 12 months
SOCIAL-ADAPTIVE DEVELOPMENT	
Expressive and receptive language behavior	Sequenced Inventory of Language Development (SILD) by speech and hearing therapist at 12 months (Hedrick and Prather)
Adaptive behavior	Bayley Behavior Scale by psychologist at 12 months
Perinatal Risk Factors	
MATERNAL RISK FACTORS	
By history	Medical record[1] and mother's report
During pregnancy	Medical record[1] and mother's report
During labor and delivery	Medical record[1] and mother's report
INFANT RISK FACTORS	
During birth	Physician's newborn exam and medical record[1]
Congenital defects	Physician's newborn exam and medical record[1]
Characteristics of Mediating Parents, Infants, and Environments	
MATERNAL CHARACTERISTICS	
Physical health	Clinic and hospital record
Perception of own health	Mother's report (home interview)
Feelings about pregnancy	Mother's report
Primary concerns	Mother's report
Attitudes about child-rearing	Mother's report
Expectation of child	Mother's report

[1]Group Health Cooperative of Puget Sound

Table 3.—Variables and sources of data—Continued

Variable	Data source
Understanding of motor and mental development	Mother's report (Alpern and Bell Developmental Profile)
Understanding of infant adaptive behavior	Mother's report (Broussard Neonatal Perception Inventory and Interview Items)
Current life events	Mother's report (Holmes SRRS)
CHILD CHARACTERISTICS	
Physical health and physical characteristics	Brazelton, Neonatal Behavioral Assessment Scale, Dubowitz Gestational Age Assessment, minor congenital anomalies (after Waldrop), mother's report of illness
Temperament characteristics	Carey Infant Temperament Characteristics
Rhythmicity of sleep-wake behavior	One-week record of sleep-wake behavior
FAMILY CHARACTERISTICS	
Demographic: parents' age, race, employment, education, and income	Mother's report
Physical environment, place of residence and type of housing	Mother's report
Social environment	
Cultural characteristics	Mother's report
Husband-wife relationship	Mother's report
Emotional support of mother	Mother's report
Physical help for mother	Mother's report
Health of family members	Mother's report
PARENT-CHILD INTERACTION AND ENVIRONMENT STIMULATION	
Animate	Caldwell Home Inventory
Maternal involvement with child	Rating scales of maternal and infant behavior during feeding session
Emotional responsivity	Rating scales of maternal and infant behavior during teaching session
Verbal and nonverbal feedback behavior of mother	Mother's report on interview items
Sensitivity of mother to needs and rhythms of child	Mother's report on interview items
Contingency of maternal responsiveness	Mother's report on interview items
Maternal efficiency	Mother's report on interview items
Maternal adaptability	Mother's report on interview items
Maternal control strategies	Mother's report on interview items
Motor activity of mother	Mother's report on interview items

Inanimate	
Maternal organization of physical environment	Mother's report on interview items
Of temporal environment	Mother's report on interview items
Provision of toys and activities for child	Mother's report on interview items
Appropriate level	Mother's report on interview items
Variety	Mother's report on interview items
Number	Mother's report on interview items
Noise level	Mother's report on interview items

NOTE: Instruments devised by the project staff will be used except where existing measures are indicated.

More complex, standardized methods will be used to establish these outcomes in the pretest for validation purposes.

The second set of variables, the perinatal risk factors, will serve two purposes. First, they will be used to stratify the sample to insure adequate representation of those children already known to be at high risk according to current knowledge. Secondly, those characteristics will serve as control variables when testing the additional discriminatory power of variables about which the known risk is less precise.

The third set of variables, the mediating characteristics of parents, infants, and environments, represent those which are expected to facilitate more precise prediction of infant outcomes and provide clues for profitable intervention.

The Study Design

In developing a screening process to enable preventive intervention, it is necessary to identify those factors associated with poor outcomes before they occur. In order to do this, a longitudinal design is essential. This approach also provides the most efficient means of testing the screening methods, because it permits examination of variability of the screening measures over time in a cohort of children. Working with children of different ages in a cross-sectional design would not permit elimination of any of the screening methods on the basis of lack of predictive validity.

The decision to begin the longitudinal testing of the assessment framework at birth was made for many reasons. Although many childhood dysfunctions do not become evident until school attendance, recent studies suggest that the course is charted early in the first few years. The Smith, Flick, Ferriss and Sellmann study (1972), which considered more risk factors than any other research reviewed, found that data gathered after age 1 year added

little to discriminating between high and low 7-year IQ's. This suggests that infancy is the most opportune time for the identification and therapeutic treatment of children at high risk of slow cognitive development.

Infancy is a particularly dynamic time of growth and change, and the period when children come under the strongest developmental forces. In aiming at preventive intervention, concentration should be placed on this important time of life before behavior patterns become fixed and problems increase in severity. This is also the period when children are usually in contact with the health care system for well-child care, immunizations and related care, and thus provides repeated opportunity for other screening and preventive practices to be added most easily to the existing armamentarium.

Little is known about the optimum time(s) within the first year of life to assess risk factors which predict future problems. The choice of ages during infancy (newborn, 1, 4, 8, 12 months) for pretesting the assessment instruments was based on (a) those periods when new developmental phases have begun, and (b) times when children would normally have contact with the health care system.

This first study phase will follow the study children through their first year of life and will be completed in 1976. The intent in later phases is to follow the sample children to school age when outcome data become stable.

The Study Families

The subjects for the study have been recruited from the population of families whose infants are delivered at the hospital of the Group Health Cooperative of Puget Sound in Seattle, Washington. This prepaid health care plan has a large membership with broad socioeconomic representation.

For purposes of assuring variability in the three sets of study factors (i.e., perinatal risk factors; parent, child and environmental characteristics; and, health and developmental outcomes), the sampling procedure is being stratified according to the level of mother's education and the occurrence of complications of pregnancy or delivery which might result in physiological trauma to the infant.

The children in the study are all first-borns. This restriction was made because of the confounding social and physical influences of multiparous maternal experiences.

The data collection for this study involves abstracting health care records, interviewing and observing study families in their

home, and office contacts with the study group for performing the necessary tests. This study is expected to benefit other children and their families through a better understanding of health personnel regarding what variables or combinations of factors relate to child health outcomes, through the development of useful screening procedures, and through the pursuit of the resulting preventive care opportunities.

Conclusion

This overview of the Seattle Study has been presented to show the background and the utilization of the literature review contained in this volume. As a starting point for a more complex analysis, it is necessary always to review the currently available evidence, since the earlier work will suggest many of the variables worth exploring further. The papers collected in this volume are intended to do just that: to review the evidence in each of several areas and to analyze the measurement problems and methods in each domain. Because the previous literature almost invariably is based on the simpler models of prediction suggested in model one and model two, we have organized the review along these lines, with one section focused on predictor variables and another section primarily concerned with outcome variables. We would like to emphasize, however, that measures of a child's functioning are really measures of predictors as well as outcomes. This is especially true for measures of the child taken early in his life, since they tell us about the sort of infant the family is responding to.

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Chapter 1

Prenatal and Perinatal Factors

Introduction

The well-accepted primary right of every child is to be born wanted and healthy, and to be nurtured by affectionate parents. It is important that the child begins life and continues life under conditions which favor his development. The annual production of a quarter of a million inadequate citizens in the United States each year is mute evidence that for many this right is abrogated by circumstances surrounding the birth process. An eloquent statement of this is given in a report from the United States Department of Health, Education, and Welfare in 1967:

> . . . The infants who survive the birth process in a condition which at best can be described as being inadequately born constitute a loss which in numbers and in cost dwarfs even the annual loss of life itself. This annual wastage of human life and human potential exceeds the combined number of deaths from all types of cancer, the number of deaths in automobile accidents each year, and the total loss of American life in the war effort of Viet Nam . . . . (U.S. Department of Health, Education, and Welfare, 1967, pages 3–4)

Until recently there has been a considerable underestimation of the magnitude of the problem of congenital malformations. In a recent investigation of pregnancy outcome (Health Insurance Plan in the New York City area) it was found that about one in four pregnancies under medical care ended in a loss or disability, 14 percent in a fetal death, 0.8 percent in a neonatal death, 4.0 percent in a low-birth-weight child, and 4.5 percent had a significant anomaly that would probably make a difference in the child's life by affecting his survival or by necessitating parental, medical, surgical, educational, and/or public attention not required by a majority of the individuals of the same age (Shapiro et al., 1968). In their 1974 publication, the National Foundation summarizes the picture of neonatal abnormalities with the following statement:

> Every year about 250,000 American babies are born with some type of defect, mental or physical. That is one in 14, or 700 babies a day—about 7 percent of all live births . . . one family in ten knows the tragedy of a child born less than perfect. (National Foundation-March of Dimes, 1974, p.8).

Who are these "inadequately born" children? From what kinds of mothers, from what kinds of pregnancies, from what kinds of births do they come? And what is their prognosis?

In reviewing the literature on this set of related questions, for convenience, the problem will be broken up into two parts. First, what factors predict perinatal difficulties or infant anomalies? Can we tell ahead of time which births, and which infants, are at high risk? Second, what is the outcome for these children a year later or 10 years later? Do they all continue to be at high risk of physical or mental or emotional ill health? Or are there mitigating environmental circumstances?

Prediction of Prenatal Risk and Infant Anomalies

Within the last 10 years, there has been a large amount of research devoted to the problem of predicting, before birth, which pregnancies will result in difficulties. As an example, Nesbitt and Aubrey (1969) developed a system of scoring prenatal factors to produce a total predictive score: women with high scores were considered to have high risk of perinatal complications while those with low scores were considered to have low risk. The "Maternal Child Health Care Index," which is their scoring tool, includes information about maternal age, race, parity, previous obstetric history, current obstetric disorders, nutrition, disease, emotional status, social class, and home financial situation. Their results provide at least a partial validation of the Index, since those mothers rated as high risk did in fact have a higher percentage of complications of various kinds than did those mothers rated as low risk.

Virtually all researchers agree with Nesbitt and Aubrey on the predictive factors, although different authors weight the various factors somewhat differently (Prechtl, 1967; Werner, Bierman and French, 1971; Haynes, 1967). In particular, maternal age, marital status, race, inadequacy of prenatal care, social class, disease state or malnutrition during pregnancy, prior obstetrical history and maternal stress are cited by virtually all authors. These predictor variables are discussed individually:

Maternal Age: Increased risk of obstetrical complications occurs at both ends of the age spectrum. Above age 40 there is increased probability of fetal anomalies and obstetrical complications; below age 20 there is increased risk as well, particularly if the mother is younger than 15 (Osofsky, 1968). However, the mother's age interacts with her social class: lower class mothers under age 20 are at high risk of perinatal complications, while middle-class

mothers in the same age range are a better than average risk (Illsley, 1967).

Marital Status: Extensive evidence supports the conclusion that unmarried mothers are at higher risk of perinatal complications. In particular, premature delivery is a common complication for the unmarried mother. Pakter (1961) reported, for example, that complications of pregnancy occurred 1½ times as frequently for the unmarried as for the married mother. However this finding, too, interacts with the social class of the mother, and the extent of prenatal care. Among the unmarried mothers, complications may result more from inadequate prenatal care than from the unmarried status itself.

Race: Equally extensive evidence indicates that women from minority groups have a higher degree of obstetrical risk than do Caucasian women (Knobloch and Pasamanick, 1963; Birch, 1968). For example, Birch (1968) reports on New York City statistics, which show that in the late 1950's, there were approximately 10 premature births per 100 live births among nonwhite women, while among whites the rate was only six premature infants per 100 live births. But, like marital status and maternal age, race is not a pure factor: social class and degree of obstetrical care are confounded with it. Pakter (1961) reports that approximately 87 percent of the married white women in his New York study had had prenatal care during the first 6 months of pregnancy, while only 61.7 percent of married nonwhites had had such care. Among the unmarried, there were no racial differences: all unmarried groups had a low probability of receiving prenatal care during the first 6 months. What all of this means is that the race of the mother probably does not mean anything by itself; race is important as a predictive factor only because it happens in our society to correlate with other variables, such as degree of prenatal care, dietary adequacy, and general physical health.

Prenatal Care: Pakter reports that for all ethnic groups, prenatal care markedly reduced the infant death rate, as well as the rate of prematurity. The likelihood of complications of pregnancy that do not result in death of the infant is also reduced if the mother has had prenatal care, particularly during the first 6 months of the pregnancy.

Social Class: Social class is of interest not because it is a causal variable but because, like race, so many other apparently causal variables are correlated with it. Richardson and Guttmacher (1967) have provided an extensive survey of the social and psychological aspects of childbearing associated with social

class. They report that women from lower social classes tend to marry early and to have many children at short intervals, to be drawn from poor regions and housing areas, and to be short in stature. In addition, among the poor there is a higher rate of unmarried pregnancies, poor diet, infectious environments, inadequate antenatal care, and inadequate postnatal care. Each of these characteristics can be shown to be independently related to sub-optimal outcomes of pregnancy. Similar findings have come out of extensive studies in Scotland (Anderson, Baird, and Thomson, 1958; Edwards, 1958).

Disease and Malnutrition: The impact of maternal malnutrition on both the birth process and on the infant at a later date is covered extensively in the paper on nutrition in this volume. Suffice it to say here that protein calorie malnutrition in mothers has been shown to be related to higher obstetrical risk (Birch, 1972). Further, a mother currently well nourished, but who was malnourished during her own prenatal period or childhood, may not only have a higher incidence of complications, but also expose the offspring to stunting and a physique which negatively affects them as reproducers (Birch, 1972).

The effect of maternal medical disorders on perinatal complications and on infant mortality and morbidity is also well established. Shapiro, Schlesinger, and Nesbitt (1968) have emphasized the importance of maternal hypoxia, while others have emphasized such disease factors as rubella, infectious diseases, diabetes, toxemia, and hypertensive cardiovascular disease. Neonatal mortality and morbidity are significantly greater among diabetic mothers. Prematurity, stillbirth, and low-birth-weight-for-gestational-age are considerably more common among mothers who have hypertensive cardiovascular disease or toxemia. Rubella is responsible for severe congenital anomalies, as are other infections such as syphilis and toxoplasmosis (Korones, 1972).

Prior Obstetrical History: Women with a history of prior fetal or child losses have a markedly higher obstetrical complication rate during their current pregnancy than do other multiparas. In Shapiro's study (1968) in New York State, the neonatal mortality rate went from 14.4 per 1,000 births where there was no prior fetal death, to 129.3 per 1,000 births where three or more fetal deaths had preceded the current pregnancy. Aside from prior fetal death, there is also a variation in risk as a function of parity. First pregnancies have a higher degree of risk than do second and third pregnancies, though the risk increases again after six pregnancies. Previous Rh sensitization predisposes to an erythroblastotic infant from the current pregnancy.

Maternal Stress: We know that physiological stresses (such as disease state, first pregnancy, extremes in the age distribution) can affect the risk of perinatal complications, but what about psychological stress? The research on this question is not outstandingly good, but seems to indicate that psychological stress, and attitudes toward the pregnancy can affect the rate of complications. Coppen (1958) studied 50 primiparous women diagnosed as having preeclamptic toxemia and 50 physically normal primiparae. He found highly significant differences between the two groups in attitudes toward menarche, premenstrual tension, attitudes toward pregnancy, relation to siblings, and emotionally disturbing events during pregnancy. He concluded that toxemic patients showed difficulty at every stage of their feminine development, that environmental factors appeared to play a role, and that psychological factors could well be implicated in a threshold concept of toxemia. Stott (1962) has also argued that emotional stress during pregnancy, including, for example, stresses associated with wartime or post-war readjustments, are associated with increased rates of not only perinatal complications but also malformations and later infantile illnesses.

These findings with humans are bolstered by the extensive evidence from animal studies which indicates that various kinds of stresses administered during the pregnancy increase the rate of malformed offspring or normal appearing offspring who are slow to learn (for example, see Thompson, 1957).

Fetal and Placental Factors: Intrauterine growth is not only associated with disorders in the mother but also with disorders of the fetus and placenta. Some factors associated with intrauterine growth retardation are multiple gestation, congenital malformations, chromosomal abnormalities, intrauterine infection, and placental pathology. The incidence of major congenital anomalies and vulnerability to neonatal illness is increased severalfold in small-for-date infants compared to those who are appropriately grown for their age (Korones, 1972).

The several available followup studies of children born with some increased initial risk are summarized in table 4, taken from Werner's summary of these same studies (Werner, Simonian, Bierman, and French, 1967). Graham's (1962) study is among the best of these. She followed for 3 years a group of infants born after prenatal or perinatal complications and found that the anoxic children were significantly poorer than controls on all measures of cognitive functioning at age 3. The anoxic children also were more likely to show positive neurological signs. The premature infants Graham studied also showed significant impair-

ment on cognitive and perceptual motor measures, although the anoxic group was worse.

Honzik et al. (1965) also found that high risk infants were more likely to have retarded or aberrant development, except in this case the followup testing was done at 8 months, rather than at 3 years. And the more "suspect" the infant at birth, the greater the likelihood of various symptoms, such as hypoactivity or hyper-

Table 4.—Summary of findings of prospective studies—relationship between perinatal complications and outcome in early childhood

Investigator	Age of followup	Type of impairment at followup[1]				
		Neurological	Motor (gross)	Perceptual motor (fine)	Intelligence	Personality
	Neonatal period					
Graham et al.	Neonatal	+				+
Prechtl	2–9 d	+				+
McGrade et al.	3–4 d					+
	Infancy and preschool period					
Honzik et al.	8 mo		+	+	+	+
Stechler	10 wk		+	+	+	
	25 mo					
	36–42 mo				0	
MacKinney	6, 12, 18				+	
	24 mo					
	36, 42, 48,					
	54, 60 mo				0	
Prechtl	2–4 yr	+			+	+
Ucko	3, 6, 9, 12					
	18 mo; 2,				0	+
	3, 4, 5 yr					
Graham et al.	3 yr	+		0	+	+
Keith et al.	"early	0			0	
	childhood"					
Niswander et al.	4 yr		0	0	0	0
Apgar et al.	5 yr				0	
Schachter and Apgar	8 yr				+	

[1]Presence of significant impairment reported by investigator is indicated by +, absence by 0, and a blank cell indicates impairment not studied. (Werner, 1967, p. 491)

activity, distractibility, poor coordination, problem solving, and eye-hand coordination. However, some of the most suspect infants tested within normal limits at age 8 months, which suggests either that the initial classification was inaccurate or that intervening environmental variables make a substantial difference in the prognosis of the infant.

Further evidence that intervening environment is crucial comes from Drillien's followup of a group of prematures (1964). He found that for the entire group of prematures studied, 20 percent of those with a birth weight of 3 pounds or less required special schooling or institutionalization. But, such a poor outcome was much more common if the infant was reared in poverty level circumstances than if the child were reared in a middle-class environment. By age 5 most of those in the middle-class environments had caught up to their full-term peers.

The Kauai study (Werner et al., 1971) also showed that environmental factors affect the course of development in a decisive way. For more than a decade all pregnancies and all births that occurred in the entire community were studied. The findings of this longitudinal study provide evidence that:

(1) Perinatal stress has a deleterious effect on the physical and intellectual status of the child at age 10. The effects of perinatal stress appeared to be greater among children whose parents were poor, had little education, or were unstable, than among children whose parents were better off economically, better educated, and more stable.

(2) The findings also demonstrated the importance of socioeconomic status in human development. A substantially higher proportion of mentally superior children came from upper- and upper-middle-class families and a relatively lower proportion came from lower working-class families.

The data from another long-term prospective study by Smith, Flick, Ferriss, and Sellmann (1972), might seem at first to be at variance with the results of the Kauai study. Smith et al. followed a group of black children from birth to age 7, collecting extensive information about prenatal events and perinatal complications, testing the child during the early years, and then assessing the child with a wide-ranging battery of cognitive measures at age 7. They analyzed their data sequentially. They began by asking which of their prenatal and perinatal measures, collectively, would best predict 7-year-old status. Seventeen variables were selected from this group, which together correctly classified 84.4 percent of the normal 7-year-olds and 76.6 percent of the abnormals. The 17 prenatal and perinatal variables that were

useful in this initial prediction were as follows (Smith, et al., 1972, p. 502):

Maternal age
Weeks gestation
Education of mother
Labor stage 1
Labor stage 2
Labor stage 3
Labor complications
Diseases of pregnancy
Infection, trimester 2
Infection, trimester 3
Age cord clamped
Age at first breath
Age at first cry
Birth weight
Apgar, 5 minutes
Highest bilirubin
I.Q. of the mother

The second step was to add the variables assessed during the first year, to see if the prediction could be improved. When an additional seven variables from the first year assessment were included, 93.3 percent of the abnormals and 94.4 percent of the normals were correctly identified. Only slight improvement in predictive power was attained by adding measurements taken during the fourth year of life.

Smith et al.'s analysis certainly suggests that the prenatal and perinatal factors are of considerable importance, indeed of greater importance perhaps than later events. But take note of the fact that among the original 17 variables are two "environmental" variables, namely maternal education and maternal IQ (although IQ may also suggest genetic differences). As pointed out in the introduction, maternal education itself is not a direct causal variable, but mothers with differing degrees of education differ markedly in their manner of treatment of the child. Thus the maternal education variable, listed as an at-birth factor, is probably more correctly thought of as a long-term environmental effect. In Smith's analysis, maternal education is the most predictive single variable among the 17 prenatal and perinatal variables.

Summary

By emphasizing the importance of the environment, we do not mean to suggest that the prenatal and perinatal factors are not

important. Certainly all the evidence indicates that extreme perinatal stress is associated with very poor long-term prognosis. But at less extreme levels, the perinatal stress variables are mediated by environmental factors, so that, to predict the outcome for a given child, information about the environment as well as the prenatal and perinatal conditions is required.

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Chapter 2

Congenital Abnormalities

As the standards and scope of medical care improve and become more accessible to a larger population, physicians, nurses, and allied health personnel are faced with the care of an increasing number of children who, in the past, would not have survived infancy. The improved diagnostic skill of the medical team and the greater accessibility of immediate intense medical care of the infant born with certain severe congenital defects should provide that infant with the best possible chance of survival. Availability of modern communication and specialized transportation contribute to this reality. Examples of infants born with the more obvious and severely handicapping major congenital defects are those with anencephaly, meningomyelocele, cyanotic congenital heart disease, trisomy 13–15, extrophy of the bladder, and tracheo-esophageal fistula.

There are other congenital malformations which are more manageable and/or correctable, which are not overwhelmingly handicapping, and which, in general, are considered to be less severe, although they are still called major defects. For example, collective experience in the recognition and management of such conditions as dislocated hips, certain types of congenital heart disease, cleft lip and palate, club feet, trisomy 21 (Down's Syndrome), XO Turner's Syndrome, umbilical hernia, rubella syndrome, ambiguous genitalia, and two vessel umbilical cords, leads one to refer to these as major congenital defects, although they are not as devastating as the first group.

Of greater interest for our purpose, however, are the so-called minor malformations (Smith, 1970) or minor physical anomalies (Waldrop, Pedersen, and Bell, 1968; Waldrop, Goering, 1971; Waldrop, Halverson, 1971) which, if they appear in clusters, seem to be predictive of more significant major congenital anomalies or of unusual behavior patterns. It is the purpose of this section to look at these minor physical variations and consider them as possible variables in the prediction of the future outcome of a child's growth and development. To be useful and meaningful as part of a screening assessment procedure, these minor physical malformations should be recognizable solely by close external

43

inspection rather than by reliance on more sophisticated tools such as radiographic contrast studies. They should also be easily discernible at birth, or shortly thereafter, and should remain relatively constant throughout life.

Definitions

Congenital malformations (occurring during fetal life) may occur at any interval along the spectrum of development from the fertilization of the ovum to the last trimester of fetal development. They may include single localized defects such as cleft lip and palate or multiple defects such as seen with the rubella syndrome. They may be due to a single unexplained insult at a specific period of embryonic development, such as tetralogy of Fallot; a genetic problem such as phenylketonuria; a chromosomal aberration like trisomy 21 (Down's syndrome); or by a foreign substance such as the rubella virus, the spirochete of syphilis, or the drug thalidimide acting on the embryo at a critical stage of development. Congenital defects may occur sporadically without clearly understood genetic influence (athyrotic hypothyroidism) or in a more predictable way with known genetic influence (phenylketonuria, achondroplasia) (Smith, 1970; Fishbein, 1961).

A congenital defect (physical anomaly or aberration) is either established at the time of fertilization or occurs as the result of an environmental factor or factors applied at some period of time during embryogenesis. It may also result from a combination of the two working one upon the other, although this latter combination would be more difficult to define. It may be a very obvious overwhelming defect, such as anencephaly, or subtle variations like the single palmar crease or epicanthal folds.

Incidence

In the papers and discussion presented at the First International Conference on Congenital Malformations, Professor Maurice Lamy and Jean Frezal (Fishbein, 1961, pp. 34–44) summarize the findings of 19 groups of investigators who looked at some 959,007 subjects, searching for congenital malformations. There apparently was considerable variation as to what the investigators thought worthy of reporting and how they obtained their data, i.e., by newborn external examination, by examination at 1 year of age or older, by examination of death certificates, by autopsy examination, by radiographic examination, or by a combination of these. The overall incidence of congenital malformations ranged from a low incidence of 0.45 percent found in 53,847 subjects

(Davis, 1957) to the high incidence of 7.5 percent found in 5,739 subjects studied (McIntosh et al., 1954). The higher incidence found in the latter study (see table 5) is probably due to the thoroughness of that particular study: pathologic examination of abortuses, stillbirths, neonatal deaths, as well as radiographic, ophthalmologic, and dental studies done on nearly all subjects at serial examinations, through the first year of life over a period of more than 5 years. It is evident that the longer one follows a patient, the more likely a congenital anomaly previously undiscovered may be recognized. This is particularly true of gastrointestinal or genitourinary tract malformations, which tend to be recognized because of increasing symptoms later in life.

Table 5.—Number and percent of infants with congenital malformations among those weighing more than 500 grams at birth, by outcome of delivery

	Total deliveries	With congenital malformations	
		Number	Percent
Antepartum deaths	81	11	13.6
Intrapartum deaths	30	7	23.3
Neonatal deaths	98	29	29.6
Live Births'	5,530	386	7.0
Total	5,739	433	7.5

'Live births excludes neonatal deaths. (McIntosh et al., 1954, page 509.)

One fact that is discouraging about McIntosh's study is that only 4.32 percent of the congenital defects were recognizable at birth. However, by the followup exam at 12 months, less than one-fifth (18.1 percent) of all malformations had not been recognized. This emphasizes the vigilance needed to continue to reexamine infants during their first year of life, watching for the appearance of congenital defects.

Of further significance is McIntosh's finding (1954) that the percent of congenital defects among live males, white and nonwhite, was more than half again as great as among females, 8.4 percent to 5.5 percent respectively. Low-birth-weight infants, 2,500 grams or less, had a higher proportion of anomalies (9.7 percent) than did those weighing over 2,500 grams (6.7 percent). In fact, the low-birth-weight female was more likely to have a congenital anomaly (11.7 percent) than the low-birth-weight male (7.5 percent); however, it should be noted that more low-birth-weight females than males survive the neonatal period. In this

particular study the rising age of the mother did not seem to have an adverse effect on the incidence of the malformations, although the risk of a later born infant having a malformation was significantly greater. Other studies, McDonald (1958) and McKeown (1961) have shown that as the age of the mother increased, so did the incidence of congenital malformations.

All studies agree that the incidence of major congenital malformations is highest in antepartum deaths, intrapartum deaths, neonatal deaths, premature infants, postmature infants, and low-birth-weight-for-length-of-gestation infants (McIntosh et al., 1954; Davis, 1957; McDonald, 1958; Fishbein, 1961; Marden, 1964; Drillien, 1970).

One of the reasons that studies of the frequency of congenital malformations have been fraught with difficulties is that most of the earlier studies (McIntosh et al., 1954; those reported in Fishbein, 1961) did not make a clear-cut division between major and minor congenital anomalies. Differences in categorization and definition of what constitutes a minor defect still result in varying reports of incidence: McDonald (1958) found an incidence of 1.5 percent major and 2.3 percent minor congenital defects, whereas Marden (1964) reported 2.04 percent major and 14.7 percent minor defects. In McDonald's study of 3,295 women, his list of minor defects included nevus, umbilical hernia, inguinal hernia, webbed fingers or toes, pilonidal sinus, abnormalities of the pinna, and others. On the other hand, Marden surveyed 4,412 babies by surface examination and use of the buccal smear for sex chromatin and included in his grouping of minor defects a number of the peculiar variations in physical appearance not considered to be minor congenital defects by others. As noted earlier, McIntosh et al. did not separate major malformations from minor ones and this resulted in such minor anomalies as hydrocele and stricture of the meatus being grouped together with more severe anomalies such as tetralogy of Fallot.

In more recent studies (Waldrop, Pedersen, and Bell, 1968; Waldrop, Goering, 1971; Waldrop, Halverson, 1971), Waldrop and her colleagues have introduced the concept of minor physical anomalies which need to be more clearly differentiated from major and minor congenital defects. Although Marden (1964) defines a minor defect as "one which is neither of medical nor cosmetic consequence to the patient (and which) may be overlooked by the physician even though it might represent a valuable clue to altered embryonic development," Waldrop et al. feel that these minor physical anomalies do contribute to or are clues to the developmental behavioral outcome of the individual.

Probably the overall incidence of major congenital defects is between 3 and 4 percent, if one makes a clear distinction between major and minor congenital malformations. A further distinction must be made between a minor congenital anomaly and a minor physical defect before an accurate estimate of the incidence of these two can be made. Lacking that distinction and combining the two would probably give an incidence of minor congenital malformations of 13 to 14 percent.

Minor Physical Anomalies

The studies of Waldrop, Pedersen, and Bell (1968); Waldrop, Goering (1971); and Waldrop, Halverson (1971) found that a high score on an index of minor physical anomalies is related to the incidence of hyperactivity in boys and possibly in girls as well. There is the strong suspicion that whatever influences embryonic development to produce such minor physical variations as epicanthal folds, hypertelorism, low-set ears, high arched narrow palate, single or double simian lines, or clinodactyly of the fifth finger, may also alter the physiology or biochemistry of the central nervous system, causing aggressive, intractable, hyperactive behavior. Or perhaps if a child has several minor physical anomalies, his strange appearance will provoke unusual responses from persons in his environment, particularly from his primary caretaker. The child then responds to an unconscious rejection or altered reactivity, in a hyperactive, less socially acceptable manner.

Waldrop, Pedersen, and Bell (1968) selected a number of physical characteristics of children and gave them weighted scores, depending on the degree to which the defect deviated from normal. These anomalies included: hard-to-comb-down, electric hair; unusually prominent epicanthal folds; hypertelorism; low-set ears; adherent ear lobes; malformed and asymmetrical ears; abnormalities of the shape of the hard palate; furrowed tongue; incurved fifth finger; single transverse palmer crease; variation of length of the third toe in relation to the second toe; partial syndactyly of the two middle toes; and an unusually wide gap between the first and second toe. Many of these characteristics are found in the infant with trisomy 21 (Down's syndrome). Since an individual defect was relatively rare, a weighted total score of the combination of all defects was used. Through an elaborate process of observation of 74 normal nursery school children (43 males and 31 females) by trained observers on different days, certain behaviors seemed to correlate with the anomaly score. Behaviors such as inability to delay gratification,

nomadic play, frenetic play, spilling and throwing, opposing peers, and perseveration were especially characteristic of both the boys and the girls who also had the highest anomaly score. The anomalies selected and their scored weight are shown in the following list:

List of Anomalies and Scoring Weights

Anomaly	Weight
Head	
Electric hair:	
Very fine hair that won't comb down	2
Fine hair that is soon awry after combing	1
Two or more whorls	0
Eyes	
Epicanthus:	
Where upper and lower lids join the nose, point of union is:	
Deeply covered	2
Partly covered	1
Hypertelorism:	
Approximate distance between tear ducts:	
Greater than or equal to 1.5 inches	2
Greater than 1.25, less than 1.5 inches	1
Ears	
Low seated:	
Bottom of ears in line with:	
Mouth (or lower)	2
Area between mouth and nose	1
Adherent lobes:	
Lower edges of ears extend:	
Upward and back toward crown of head	2
Straight back toward back of neck	1
Malformed ears	1
Asymetrical ears	1
Soft and pliable ears	0
Mouth	
High palate:	
Roof of mouth:	
Definitely steepled	2
Flat and narrow at the top	1
Furrowed tongue (one with deep ridges)	1
Smooth-rough spots on tongue	0

Hands

Fifth finger:	
Markedly curved inward toward fingers	2
Slightly curved inward toward other fingers	1
Single transverse palmar crease	1
Index finger longer than middle finger	0

Feet

Third toe:	
Definitely longer than second toe	2
Appears equal in length to second toe	1
Partial syndactylia of two middle toes	1
Gap between first and second toe (approximately greater than or equal to ¼ inch)	1

(Waldrop, Pedersen, Bell, 1968, p. 394.)

It should be realized that this was not a prospective study and that the minor physical anomalies were not identified in the newborn period. There was no study of the possible sequence of environmental events that led to the associated behavior in the nursery school period. It was the impression of the investigator, however, "that mothers of children with numerous minor physical defects tended to be less supportive and more restrictive than mothers of children with few or no defects" (Waldrop, Pedersen, and Bell, 1968, p. 399).

In a later study Waldrop and Halverson attempted to replicate the first study, and again found that boys with high anomaly scores are likely to be more hyperactive and organically driven in their behavior (summarized in Waldrop, Goering, 1971). However, this same relationship is not found for girls. In fact, they report that the girls with the higher anomaly score tend to be more inhibited and fearful. As pointed out, "high anomaly children of both sexes seem to have trouble with impulse control, too much for girls and too little for boys" (Waldrop, Goering, 1971, p. 603). They also report that a followup study of the original 74 nursery school children 5 years later shows that the selected anomalies and the greater hyperactivity in a free play situation were still correlated (Waldrop, Goering, 1971, p. 604).

In another study (Waldrop, Goering, 1971), having fine electric hair was dropped as an anomaly and head circumference substituted. The subjects for this second study were pupils selected by the teachers and principal of a school as being the most hyperactive and uncontrolled children in the classroom. These were

matched with children similarly selected as having an average range of behavior. In the study group there were a total of 46 children, of which 12 were female and 34 male. In the control group there were 44 average children, 26 of which were female and 18 male. The teachers and principal were not made aware of the hypothesis to be tested, namely that the most fast moving children would have more minor physical anomalies than children judged to exhibit a normal range of behavior. The investigator who examined these children for the anomalies had no prior knowledge of the children's behavior and spent so little time with the child that she did not have an opportunity to judge the behavior in her allotted 5-minute examination time. The results of this study suggest that for boys minor physical anomalies are associated with hyperactive behavior. That the male has a disadvantage as far as developmental outcome is concerned has been recognized by others (Marden, 1964; Singer et al., 1968; Johnson, 1971, Weiss et al., 1971). Just exactly why certain stresses affect the male more than the female is not certain, although a genetic influence or susceptibility must be considered.

In 1968, Chess reported on longitudinal behavioral-educational studies of 136 children of middle-class families with high educational background, plus all the children of 95 working-class Puerto Rican families, and also 52 mentally retarded children. In each study, an attempt was made to identify "temperamental individuality" (Chess, 1968, p. 2232) and see how this influenced the child's learning processes. Nine categories of temperament were identified:

1. Activity level: The motor component present in a given child's functioning, and the diurnal proportion of active and inactive periods.
2. Rhythmicity: The predictability of such functions as hunger, feeding pattern, elimination, and sleep-wake cycle.
3. Approach or withdrawal: The nature of the child's response to a new food, object, or person.
4. Adaptability: The speed and ease with which current behavior can be modified in response to altered environmental structuring.
5. Intensity of reaction: The energy level of response, irrespective of its quality or direction.
6. Threshold of responsiveness: The intensity level of stimulation required to evoke discernible response to sensory stimuli, environmental objects, and social contacts.
7. Quality of mood: The amount of pleasant, joyful, or friendly

behavior as contrasted with unpleasant, unfriendly behavior, or crying.

8. Distractibility: The effectiveness of extraneous environmental stimuli in interfering with, or in altering the direction of, ongoing behavior.
9. Attention span and persistence: These two categories are related. Attention span concerns the length of time a particular activity is pursued by the child. Persistence refers to the continuation of an activity in the face of obstacles to the maintenance of the activity.

This descriptive list closely resembles the behavior variables mentioned by Waldrop and Halverson (1971). Such behavior as inability to delay gratification, nomadic play, frenetic play, spilling and throwing, opposing peers and perseveration may be innate characteristics of some children, especially boys, if in addition they show multiple minor physical variations or anomalies.

Using a total score of minor physical anomalies as a predictor for prospective developmental outcome in the Nursing Child Assessment Project, seems both reasonable and useful. Waldrop's "fine electric hair" will not be used as one of the characteristics because of the sparseness of hair in some children under 1 year of age. Frontal hair whorl, mean palpebral fissure lengths, auricular length and bridged palmar transverse crease will be added as the author thinks these may be significantly related to behavior variables.

Thus, the list of anomalies (given below) is derived in the most part from the several studies by Waldrop summarized in Volume II, *The Exceptional Infant* (1971, p. 359). Some additions and variations have been made to better accommodate the need of the Nursing Child Assessment Project. It is recommended that a notation be made concerning each of these minor anomalies at each visit, knowing that some may change (epicanthal folds, wide space between toes) and others will remain fixed (incurved fifth finger, single palmar crease).

The physical characteristics then will be as follows:

Revised List of Anomalies with Scoring Weights

Anomaly	Weight
Head	
Circumference out of normal range for each age level:	
Equal to or greater than 1.5 S.D. above or below normal	2

Anomaly	Weight
Equal to or between 1.0 and 1.4 S.D. above or below normal	1
Frontal hair whorl	1
Two or more hair whorls	0

The head circumference will be measured over the occipital protuberance, the supraorbital ridge and 1 cm above the helix of the ear and plotted on a standard head measurement table. See figure 4, page 48. Frontal hair whorl was added because of its association with underlying cranial defects.

Eyes

Epicanthus: where upper and lower lid join the nose, point of union is:	
Deeply covered (lacrimal caruncle not seen)	2
Partly covered (lacrimal caruncle partially seen)	1

It is critical that the natural epicanthal folds of the oriental and other races be specified. Care must be taken not to mistake the natural fullness and fatness in this area in the newborn with the epicanthal folds. See figure 5, page 49.

Hypertelorism:	
Equal to or greater than 1.5 S.D. above or below normal	2
Equal to or below 1.0 and 1.4 S.D. above or below normal	1

The degree of hypertelorism is to be ascertained by plotting the intracanthal distances on a standard chart. See figure 6, page 50. Caution must be exercised in measuring the intracanthal distance on prematures. This measure would better be taken at 4 or 8 months for greater accuracy.

Palpebral fissure length of less than 2.0 cm at 1 year of age	1

The length, measured in centimeters, between the inner (nasal) canthus (angle) and the outer (temporal) canthus of the eye. See figure 5. The mean palpebral fissure length at birth is 1.9 cm, at 6 months is 2.1 cm, at 10 months is 2.2 cm, at 14 months is 2.3 cm.

Ears

Low seated:	
Top juncture of ear is below line extended from nasal bridge through outer corner of eye by:	
less than 0.5 cm	2
greater than or equal to 0.5 cm	1

Anomaly	Weight
Auricular length: (Smith, 1972, p. 360)	
less than or equal to 3.5 cm	2
3.6 to 4.2 cm	1
Adherent lobes:	
Lower edges of ears extend:	
Upward and back toward crown of head	2
Straight back toward back of neck	1
See figure 7, page 51.	
Malformed ears	1
Asymmetrical ears	1
Soft pliable ears	0
Mouth	
High palate: roof of mouth:	
Definitely steepled	2
Flat and narrow at top	1
See figure 8, page 52.	
Furrowed tongue (one with deep ridges)	1
Smooth-rough spots on tongue (geographic tongue)	0
Hands	
Fifth finger:	
Marked curve inwards towards other fingers	2
Slight curve inwards towards other fingers	1
(should be noted as bilateral or unilateral)	
Palmar transverse crease:	
Bilateral	2
Unilateral	1
Bridged	1
Sydney Line	0
See figure 9, page 53.	
Feet	
Third toe:	
Definitely longer than second toe	2
Appears equal in length to second toe	1
Partial syndactyly of the two middle toes	1
Gap between first and second toe (approximately greater than or equal to ¼ inch)	1
See figure 10, page 54.	

Figure 4.—Head circumference

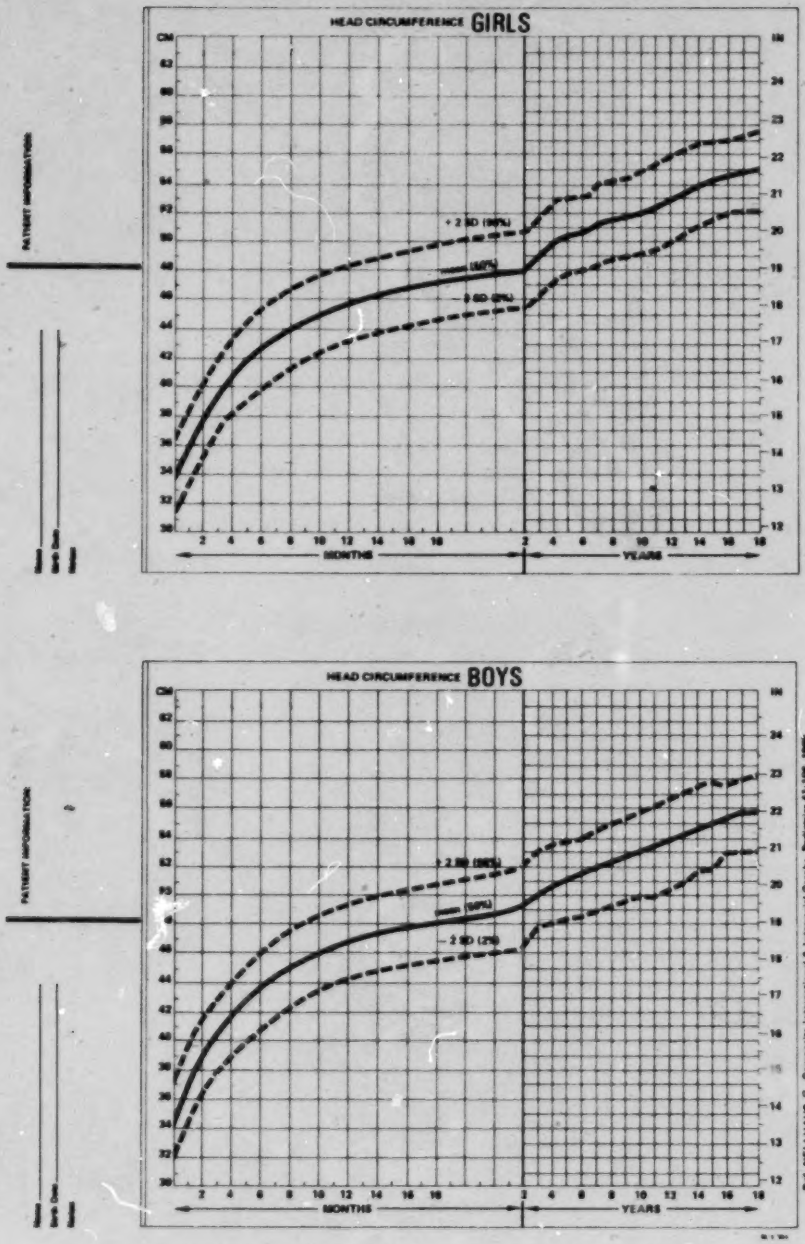

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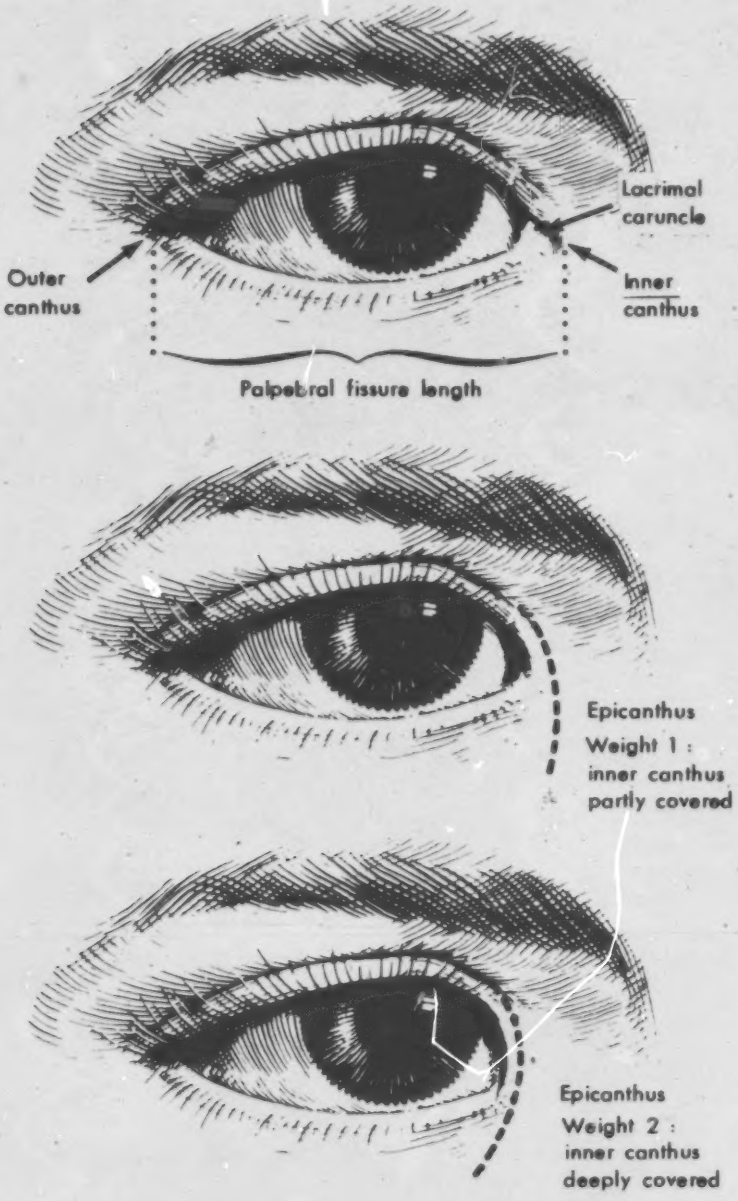
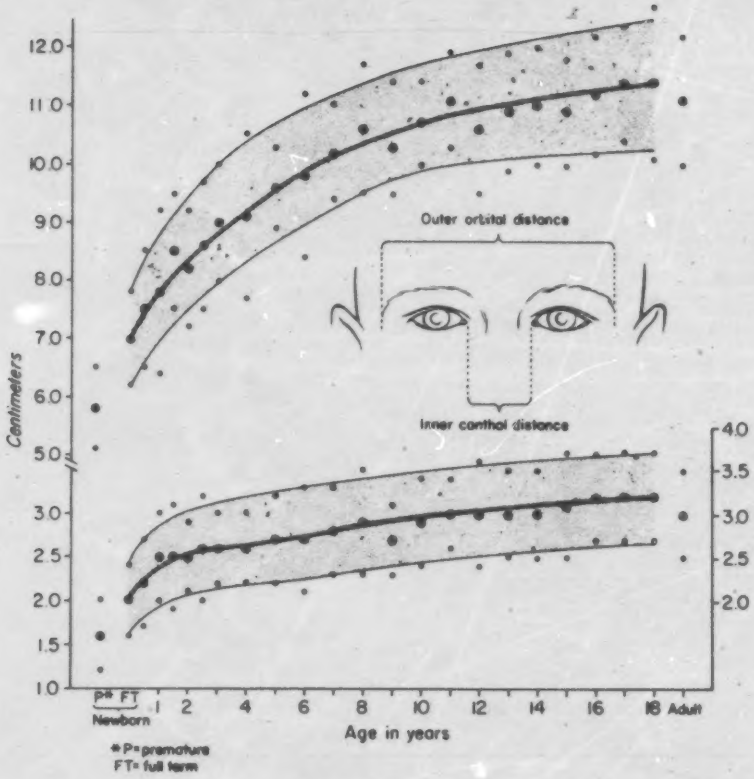
Figure 5.—Minor anomalies of the eyes



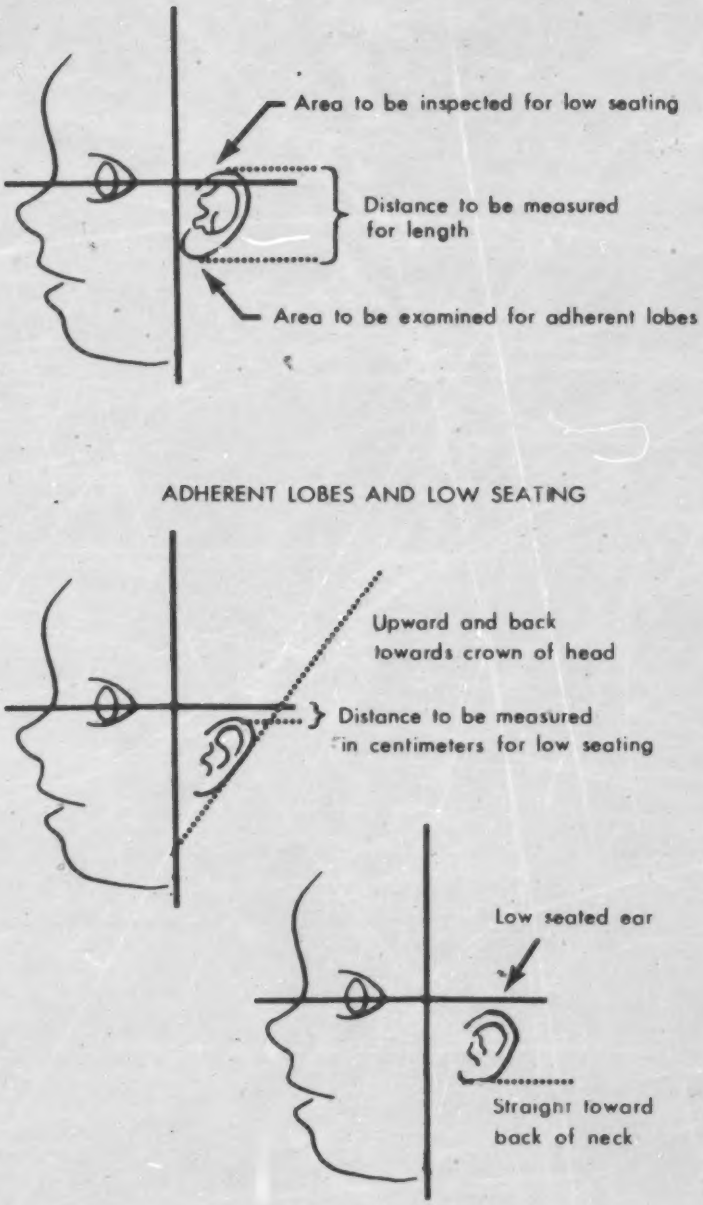
Adapted from Waldrop, Halverson, 1971, p. 347.

Figure 6.—Inner canthal and outer orbital distances



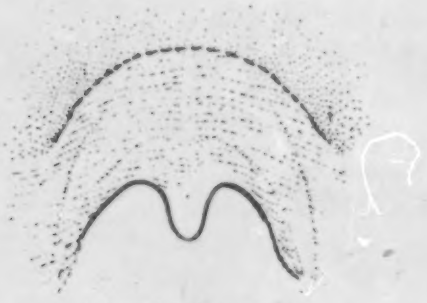
The large points represent the mean value for each age group, and the smaller points represent two standard deviations from the mean. The heavy line approximates the fiftieth percentile, while the shaded area roughly encompasses the range from the third to the ninety-seventh percentile (Laestadius, Aase, Smith, p. 467, 1969).

Figure 7.—Minor anomalies of the ears

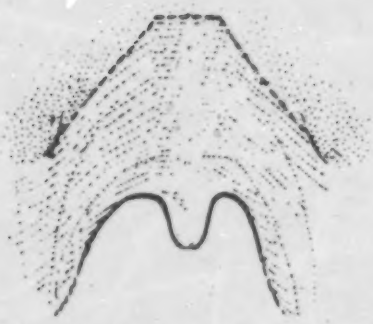

Area to be inspected for low seating
Distance to be measured for length
Area to be examined for adherent lobes
ADHERENT LOBES AND LOW SEATING
Upward and back towards crown of head
Distance to be measured in centimeters for low seating
Low seated ear
Straight toward back of neck

Adapted from Waldrop, Halverson, 1971, pp. 350-352.

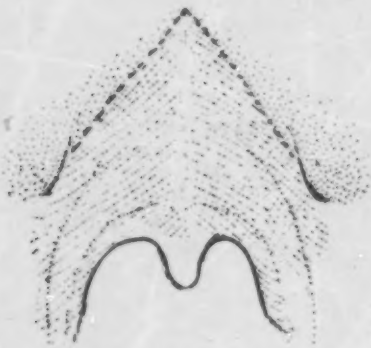
Figure 8.—Minor anomalies of the mouth



Normal palate arch



Flat and narrow at top - Weight 1

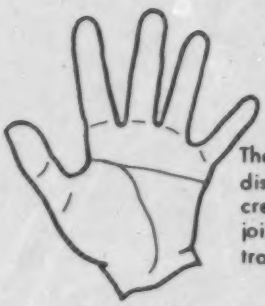


Steepled palate - Weight 2

Adapted from Waldrop, Halverson, 1971, p. 353.

Figure 9.—Minor anomalies of the hands

Normal palmar creases and variations



The proximal and distal horizontal creases are clearly joined in a single transverse line.

Single palmar crease - Weight 1

Bridge palmar crease

Sidney line

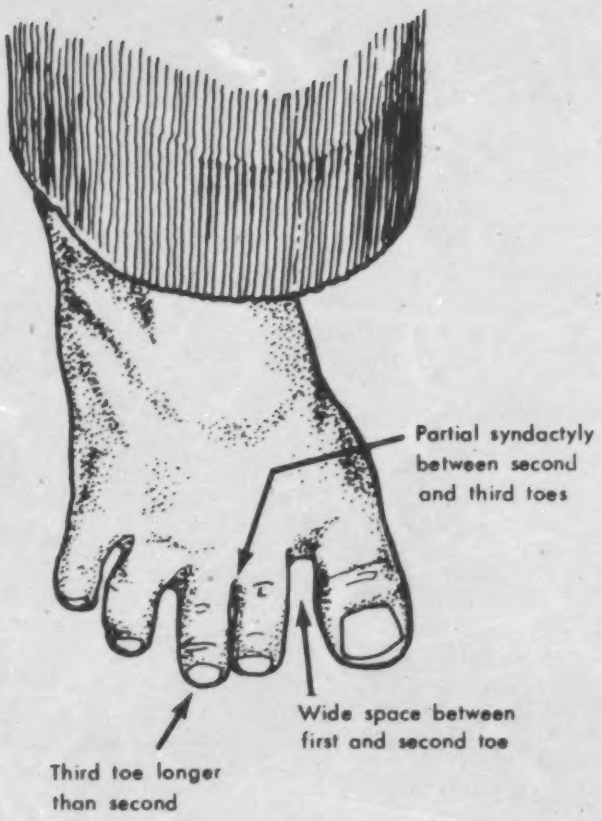
Proximal transverse crease extends beyond the hypothenar eminence to the ulnar margin of the palm. (found in association with childhood leukemia)

Fifth finger

Marked curve inwards towards other fingers. Weight 2

Adapted from Johnson, Opitz, 1971.

Figure 10.—Minor anomalies of the foot



Adapted from Waldrop, Halverson, 1971, p. 358.

Conclusion

It is evident from the review of literature that in the past there have been vast differences of opinion as to the definition and categorization of minor physical anomalies. This has resulted in confusion as to the true incidence of minor anomalies in children and also to the importance they hold in child development.

Recent research has shown, however, that when clusters of minor physical anomalies appear together, they become predictive of either significant major congenital anomalies or of unusual behavior patterns. Thus it becomes imperative to develop a clearly identifiable method for classifying these anomalies. A modification of the Waldrop system has been presented in this paper as a means of systematically identifying and weighing specific minor anomalies which may become predictor variables for identifying the child who is "at risk" for physical behavior problems.

Furthermore, the recent findings of Jones, Smith, Ulleland and Streissguth (1973), and Jones and Smith (1973), suggest that infants born to alcoholic mothers have many of the same minor physical anomalies described in the Waldrop studies. Infants representing the "fetal alcohol syndrome" characteristically show microcephaly, short palpebral fissures, epicanthal folds, maxillary hypoplasia, joint anomalies, altered palmar crease patterns, cardiac anomalies and difficulty with fine and gross motor function. The eight subjects of these studies were infants or children under the age of 4 years. Two other older children (7 and 10 years) with the fetal alcohol syndrome, in this author's private practice, not only show all the minor physical anomalies but have a severe behavior disorder characterized by marked distractibility, hyperactivity, short attention span and learning disorders. Whether the combination of unusual behavior patterns and minor physical anomalies is due to an early gestational nutritional or enzymatic deficiency, or is due to some toxic effect of the alcohol on the developing fetus, is not known. The important factor is that Waldrop's subjects and Jones's cases have many similarities suggesting that certain unknown factors in early embryogenesis profoundly influence physical as well as behavioral development.

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63

Chapter 3

Nutrition

The nutritional assessment of children is important, but a simple effective method for assessing nutritional status does not exist. If it did, the question of the prevalence of child malnutrition in this country could be easily answered. With convincing documentation, nutrition programs would receive more widespread support.

At present the evaluation of nutritional status is difficult and expensive, and, therefore, not widely used or easily available. Furthermore, the methodology is not well worked out. This has led the Maternal and Child Health Division of the U. S. Public Health Service to urge the use of simple screening methods for first level detection of children at risk (DHEW (HSM)73–5603, 1973).

This paper (1) examines the factors which influence the nutritional status of children in this country; (2) reviews the existing procedures for status assessment; and (3) analyzes the problems of predicting the future effects of present malnutrition.

Factors Influencing Nutritional Status

Two national nutrition surveys, *The Ten-State Nutrition Survey* (DHEW Publications No. (HSM) 72–8130, (HSM) 72–8134, 1972) and the *Health and Nutrition Examination Survey*, (DHEW Publication (HSM) 74–1219–1), have described some of the environmental factors influencing the nutritional status of American children. They have also identified those children at greatest risk for nutrient deficiency and for obesity. A brief summary of selected findings from these recent studies, along with related research concerning factors known to influence nutritional status, will be presented.

Food Available

The food which children eat is, of course, paramount in determining their nutritional status. Further, nutritional status at any one time is the result of the individual's nutriture and the opportunity to grow over time. Thomson and Billewicz (1963, p. 58) attributed their finding that taller women have heavier

babies than shorter women to the fact that the taller women were better nourished in their own childhood. Before birth, the availability of food to the fetus in utero is influenced by the mother's nutriture and her diet during pregnancy: heavier women with substantial weight gain during pregnancy have heavier babies and lower rates of prematurity than lighter weight women who experience only a slight gain or even fail to gain during pregnancy (Singer, Westphal, and Niswander, 1968, p. 419; Eastman and Jackson, 1968, p. 1023). This is important because low-birthweight babies are at higher risk of poor neurological and intellectual functioning (Drillien, 1964, 1970a, 1970b). After birth, the greater the caloric value of the food intake, the greater the weight gain of infants studied during the period 8 to 42 days (Fomon et al., 1969, p. 249). For further discussion, see chapter 7.

These findings can be interpreted to illustrate that long-term, as well as current, nutritional status of the pregnant woman has an effect on the availability of nutriture for the growing fetus. The stature and weight of the mother prior to pregnancy, as well as her weight gain during pregnancy, are important because they influence the length of pregnancy and the intrauterine weight gain of the fetus and therefore are determinants of infant growth and development.

Genetic Influence

The characteristics of a child that determine how much food he eats, how well he utilizes it, and his subsequent growth and development may be genetically determined. The Ten-State Nutrition Survey found, for instance, that blacks were taller than whites during the growing period and were more advanced in skeletal development despite the fact that they were less well-nourished (DHEW (HSM) 72-8131, 1972, p. III-7). Studies to determine the incidence of obesity in children appear to show some genetic influence; if parents are of normal weight, 10 percent of the children will be obese; if one parent is obese, approximately 50 percent of the children will be obese; and if both parents are obese, 80 percent of the children will be obese. Although this relationship is also affected by familial influences, several authors (Mayer, 1957, 1966; McCracken, 1962, p. 109; Withers, 1964), observing that infants adopted into families with obese parents do not become obese, have attributed these findings to genetics.

Early Feeding Patterns

Early feeding patterns are thought to establish a child's pattern

of nutritional status. Infants who gain weight rapidly in early infancy have a significantly higher incidence of obesity at ages 6 and 8 years than those who gain weight slowly (Eid, 1970, p. 75) and obese children have been found to have been markedly obese since infancy and early childhood (Asher, 1966, p. 673; Rony, 1932). Longer term studies have shown that a high percentage (44 to 86 percent) of obese children become obese adults (Asher, 1966; Abraham and Nordsieck, 1960; Lloyd, Wolff and Whelen, 1961; Mendelson, Weinberg and Stunkard, 1961).

The effect of early feeding practices on the adipose cells of rats was studied by Knittle and Hirsch. They found that rats raised in small litters had significantly more and larger adipose cells in their epididymal fat pads than did paired siblings suckled in large litters (Knittle and Hirsch, 1968, p. 2094). Dietary manipulation failed to effect permanent changes after 10 weeks, indicating that for rats, a time limit does exist during which diet can alter adipose tissue cellularity. Similar observations have been found in humans. Hirsch and Knittle (1966) compared subjects of average weight with obese subjects and found a three-fold elevation in the number of adipose cells and more lipid per cell in the obese subjects. Even after reducing the obese subjects still had a fixed high number of adipose cells, even though the cell size varied greatly with weight changes (Hirsch and Knittle, 1966, p. 1023).

The inference from these studies is that early over-feeding increases the number of fat cells and lipids. Since the number of cells remains even after dieting, the potential for obesity remains. Studies of food intake, activity, and other parameters of behavior are needed to determine their effects on fat cells.

One other aspect of the problems of obesity is emphasized by Christakis (1973, p. iii). He states that, although it is quite natural for the lay public to consider that the obesity represents an excess of nutritional stores, this is not always the case. Instead, obese individuals are often malnourished with regard to specific nutrients and may be patently anemic.

Education

The educational attainment of the person responsible for buying and preparing the family's food has been shown to be related to the nutritional status of children under 17. As the years of schooling of the mother or major caretaker increased, the prevalence of multiple "deficient" and "low" values[1] for blood and urine

[1]In the Ten-State Nutrition Survey, values below certain selected concentrations were classified as "low," and all values below the lower limit

constituents decreased (DHEW (HSM) 72–8132, p. IV-290). Also, the vitamin A status of young persons in low-income-ratio States[2] appeared to improve with the number of years of schooling completed by the mother (ibid., p. IV-136). And, in another study (Rosenwaike, 1971, p. 649), the incidence of low-birth weight infants was lower among better educated women, who tend to have higher socioeconomic status and hence perhaps better nutrition, than among women with less education.

Age and Sex

Iron deficiency anemia, as evidenced by a high prevalence of "deficient" and "low" levels of hemoglobin, is a problem for children, especially if they are black (DHEW (HSM) 72–8132, 1972, p. IV-4). This does not appear to be age related. A child's susceptibility to nutritional deprivation, however, is greater during periods of rapid growth such as occurs in infancy and adolescence.

In the Ten-State Nutrition Survey, there was generally a higher percentage of males with "deficient" and "low" hemoglobin values than females. This was an unexpected finding and the authors suggest that it might not reflect true rates of anemia, but rather that the standards used are inappropriate (DHEW (HSM) 72–8132, p. IV-5).

Income

Income has been identified as a major determinant of nutritional status. Higher income is associated with more advanced infant growth and development, and malnutrition has been shown to increase as income level decreases; this relationship continues to hold when ethnic background is taken into account (DHEW (HSM) 72–8131, p. III–9). The Ten-State Nutrition Survey also found that the prevalence of multiple "deficient" and "low" bio-

of the low range were classified as "deficient." The authors caution against concluding that all persons classified as "deficient" in a specific blood or urine constituent would exhibit clinical signs of nutrient deficiencies. On the other hand, they state that it can be assumed that persons with "deficient" or "low" values are more likely to be at risk of developing physiological or metabolic disturbances related to nutrient deficiencies (DHEW, (HSM) 72–8132, p. IV–1).

[2]The 10 States in the Ten-State Nutrition Survey were divided into two large subsamples based on a Poverty Income Ratio (PIR) for each family as proposed by Orshansky (1968) and based on factors affecting family income such as family size, sex of the head of household, and place of residence. In the five "low-income-ratio States" more than half of the families were living at a "below poverty" level, whereas in the five "high-income-ratio States," more than half of the families were classified as living "above poverty" (DHEW (HSM) 72–8134, pp. 2, 7).

chemical values was higher in low-income-ratio States than in high-income-ratio States (DHEW (HSM) 72-8132, p. IV-290).

Activity

Infantile obesity appears to be related to physical activity. Pertinent to this is Rose and Mayer's demonstration that, due to differences in activity, thin babies remained thin despite an unusually high caloric intake, and fat babies remained fat despite their unusually low caloric intake. "The average obese infant . . . was not the one who consumed more calories per kilogram . . . but the one who expended fewer calories on activities" (Rose and Mayer, 1968, p. 26). Genetically determined characteristics in a child can influence coordination and athletic ability and ease of participation in sports. An indirect influence is seen in children who are physically very active and suffer fatigue which can lead to a pattern of being too tired to eat and hence to under-nutrition.

Sociocultural Factors

One way in which cultural factors affect nutrition is by conditioning of attitudes toward body size. To some, thinness is synonmous with youth, health, beauty, an active life style, efficiency and success. Goldblatt (1965, p. 100), for example, found that with increasing social status, women moved from the obese to the thin category and men moved from the obese to normal. Obesity was considered normal in the lower socioeconomic classes, whereas, in the higher socioeconomic classes, greater social value was placed on thinness.

Psychological Stress and Anxiety States

Increased food intake is often a response to anxiety, emotional tension, and insecurity. Bruch (1957) concludes from her studies of children that obesity may develop during the growth years when the children are not helped to withstand psychosocial conflicts.

There is some evidence that how one perceives and reacts to stressful situations can influence metabolism. For instance, the stress of a final exam at MIT caused freshman students to go into negative nitrogen balance (Scrimshaw, 1963, p. 201). Whether these relationships also hold for children or what patterns of psychological factors are associated with intake and nutrition await further study.

Disease and Disabling Factors

Congenital malformations, genetic aberrations, gastrointestinal

disorders, malignancy, and endocrine disorders affect digestion, utilization, storage, requirement, destruction and excretion of nutrients. Almost all chronic infections produce changes capable of influencing nutritional status (Scrimshaw, Taylor, and Gordon, 1968, p. 59). And acute disease may alter nutrition temporarily, either through loss of appetite and intake or through therapeutic measures which interfere with the digestion or absorption of nutrients.

Medical Practice

Sometimes inappropriate nutrient restriction is a result of medical practice. For instance, Fraser (1965, p. 59) described a child, 9 months of age, admitted to the hospital with a diagnosis of xerophthalmia, hyperkeratosis, scurvy, and mild rickets. Because of an allergy, he had been given a proprietory soybean formula but no vitamin supplements, despite signs of vitamin deficiency. On the other hand, a toxic state of over-nutrition can be produced by supplementation if it is not carefully monitored as to amount and length of time given.

Conclusion

From a summary of these factors, it becomes obvious that with so many variables influencing nutritional status, one could predict that assessment of nutritional status must include a comprehensive evaluation of the individual, his background, and his environment. The next section surveys the common modes of assessment.

Nutritional Status and Its Assessment

Effective use and interpretation of screening methods requires an understanding of nutritional status: what it is; how it is assessed; and which factors influence it. Since we have already reviewed the associated factors, we can now move on to define measurement of nutritional status: nutritional status is that condition or state of health resulting from utilization of available essential nutrients (Morgan, 1959). Assessment of nutritional status usually seeks four different kinds of data, each of which sheds light on one side of the problem:

1. Dietary studies: to investigate type and amount of food eaten
2. Laboratory studies: to determine various nutrient levels in blood and urine
3. Clinical examination: to detect visible signs of malnutrition

1. Body measurements: to analyze growth patterns

Poor, fair, or good status are terms often used but should be avoided unless proper criteria are established (Christakis, 1973, p. 19). Sinclair's concept of the various levels of status, however, is useful for our understanding:

> 1. Excess nutriture: The state in which impaired function or defective structure results from an excessive supply to certain cells of the body of one or more aliments or nutrients.
> 2. Normal nutriture: The state in which function and structure are unimpaired by nutrition, and the reserves are adequate for the usual needs of the body.
> 3. Poor nutriture: The state in which function and structure are unimpaired by nutrition, but the reserves are inadequate for the usual needs of the body.
> 4. Latent malnutriture: The state in which function or structure is impaired by nutrition, but disease exists only in . . . an undeveloped form.
> 5. Clinical malnutriture: The state in which impaired function or defective structure, produced by nutrition, causes definite disease, even though this may not be capable of diagnosis by a physical examination. (Sinclair, 1948, p. 106)

The cut-off points between these levels are not exact. Neither do they give any information regarding utilization of nutrients available or degree of depletion of an individual. A child with marginal nutrient intake, for example, can be in one of several depletion stages, and while dietary study can indicate which nutrients are available to the body, it does not establish how well they are utilized or what stage of depletion the child is in.

The laboratory assessment of biological fluids offers the most precise approach available for evaluating a child's condition. For instance, concentrations of hemoglobin proteins, cholesterol, and vitamin A in blood are fairly stable measurements which reflect long-term dietary influences to a considerable extent (Christakis, 1973, p. 44). Furthermore, biochemical lesions show up before clinical lesions, so that problems identified by biochemical studies can be treated before a marginal deficiency leads to overt signs and a state of disease. This was shown in the recent Ten-State Nutrition Survey: clinical signs (Bitot's spots, which are well-delineated white lesions of the eye, indicative of vitamin A deficiency) were found in only one child, but the biochemical data and dietary analyses identified a major problem in regard to vitamin A among Spanish Americans in low-income-ratio States, mainly Mexican Americans in Texas (DHEW (HSM) 72–8132 1972, p. IV-137).

Visible stigmata of nutrient deficiency appear only after a prolonged period of malnutrition, and they are not often seen in

developed countries. Therefore, the design of the Health and Nutrition Examination Survey to measure the status of United States populations was based on the assumption that evidence of malnutrition in these populations would be mainly subclinical. In the absence of clinical signs, evaluation of status depends on dietary, anthropometric and laboratory data. Discussion of the limitations and sources of error for each of these follows:

Although laboratory data are more precise than dietary and clinical data, their interpretation is often difficult and the test results differ in their reproducibility. Furthermore, blood levels of nutrients may reflect only recent intake without giving any indication of nutrient stores. Diet and disease also affect blood and urine nutrient levels, but an even greater shortcoming of laboratory data is the fact that nutritionists disagree on how low a level indicates risk and deficiency.

The so-called cut-off points for many nutrients have not been determined, and, therefore, a supposed deficiency may merely be an artifact of the standard.

If the dietary information supports the laboratory results, a clearer view of nutritional status emerges. But dietary intake data is subject to its own errors: errors in estimation; failure of memory; errors and inadequacies in food tables used to calculate the nutrient content of the diets; and, finally, errors based on the comparison standard which is usually the Recommended Daily Dietary Allowance (RDA). The values in this standard are set above the average physiological requirement for each nutrient. Therefore, failure to meet the RDA standard does not necessarily mean malnutrition (Christakis, 1973, p. 13). Furthermore, the physiological requirements for many nutrients are still unknown.

Anthropometric measurements which indicate retarded growth and development support other data suggesting that a nutrition problem exists, but abnormal growth patterns are not evidence of malnutrition per se. Slow growth may reflect other variables such as a disease state or a genetic factor. An illustration of the complexity of interpreting growth data is seen in the Ten-State Nutrition Survey finding of an excess of undersized children when compared to standards commonly used in the United States (DHEW (HSM) 72–8134, p. 11). A meaningful assessment of the significance of this finding is difficult because the available standards are based on measurements made 30 to 40 years ago on small numbers of children. The Stuart-Meredith norms are based on height and weight measurements of white, Boston children, age 1 to 4 years, made in the early 1940's (see chapter 7). This situation highlights one major problem in the assessment of nutri-

tion: the inadequacy of current standards. In addition, the Ten-State Nutrition Survey found that, in general, blacks showed advanced maturation and growth relative to whites even though the black population was generally less well-nourished (DHEW (HSM 72–8131 p. III–15); this again indicates the need for more recent and perhaps differential standards for valid evaluation of the physical growth of all children.

The best possible picture of nutritional status is presented by the evaluation of all four types of data combined: the food consumed, the biochemical indices, the weight and growth pattern, and if present, the visible stigmata of malnutrition. The maximal assessment of nutritional status involves the four major sources of data reviewed, and specific techniques are available for obtaining this information. How and what to screen for to identify children at high risk will be discussed in the following section.

Screening Methods

Screening provides an approach for differentiating children at risk and not at risk for nutritional problems. Anthropometric measurements in neonates, such as length and weight for gestational age, and skinfold thickness, can help to distinguish intrauterine growth retardation, small-for-date babies, dysmaturity and postmaturity. Furthermore, the screening procedure can lead to suggestions as to target groups where nutrition education, counseling and support are needed. For example, identification of children from families with a hereditary predisposition to obesity would suggest encouraging participation in preventive programs relative to activity and diet. Or, a broad estimate of nutrition based on serial measurements of body weight and height can be used as a basis for counseling. Finding a combination of characteristics associated with unfavorable nutrition in a single child indicates greater risk than the existence of any one unfavorable characteristic by itself.

The depth of the screening and the amount of data collected varies with the questions to be addressed and with the time and personnel available. Anthropometric measures of height, weight, and head circumference plotted sequentially on growth charts serve well as a basic screening system for detecting physical growth problems. Laboratory measures at this level would include hematocrit and hemoglobin determinations. Selected demographic information adds to the detection system. The following review of possible screening information gives a description of the range of variables and the potential information they yield. There is no

attempt to suggest a particular "best" set of questions or variables for screening; this can only be decided with consideration of the characteristics of the population being screened.

General

A general description, such as date of birth, age, sex, ethnic background, race, number in the family, ages and sex of siblings, age of parents, and height and weight of parents identifies the child and his family. Some knowledge of the geographic area, socioeconomic make-up, health problems, and vital statistics of the sub-segment of the population from which the child comes is helpful as a place to begin.

The medical history—including birth weight, occurrence of serious or chronic illness, infections, physical defects, medications or disorders which could affect whether the food is assimilated and utilized—is helpful.

Information on birth weight and length, gestational age at birth, head size, length of breast feeding, growth rate over time, skinfold measurements, morbidity, length of time in the hospital after birth, weight and age at discharge can be used to screen for problems needing nutritional assistance.

Socioeconomic Data

Socioeconomic variables such as income and education level of the person who buys and prepares the food are known to be associated with the quality of nutrient intake. The socioeconomic status of the head of the family can be rated by a variety of established indices, for instance Hollingshead (1957) or Orshansky (1968).

Anthropometric Data

It has already been inferred that body weight and length measurements made serially provide a measure of growth adequacy or growth failure. The final size attained is limited by heredity, but whether or not an individual realizes his full growth potential is determined largely by nutrition. The most dramatic example of this has been in post-World War II Japan where children have been found to grow as much as 3 inches taller than their parents (Insull, Oiso and Tsuchiya, 1968, p. 771). The extent to which undernutrition influences the size of an individual is dependent on the timing and duration of the insult. The greatest effects are seen at the periods of maximum growth, which occur during the first year of life and at time of puberty. Growth proceeds most rapidly during the first year; there is a gradual decline during the

second and third years; about the eighth year, the rate of growth begins to accelerate and reaches its maximum during adolescence; then it gradually declines until it ceases. Growth is highly individualistic, however, and it varies within this pattern depending upon genetic and environmental factors. In terms of nutrition, height and weight deviations are significant only when they are extreme and when there is additional evidence of undernutrition, such as loss of vigor.

Head circumference measurement is a standard procedure in pediatric practice. It is particularly useful in detecting pathological conditions such as hydrocephalus or microcephaly. Head circumference is related to brain size, so that during the first year, as brain size increases, head circumference increases also. The human brain develops most rapidly during the last trimester of pregnancy and more slowly in infancy, with growth essentially completed by 2 years of age (Dobbing, 1967, p. 82).

Chest circumference and head circumference are about the same until 6 months of age. Thereafter, the head grows more slowly and the chest more rapidly, so that, between the ages of 6 months and 5 years, a chest/head circumference ratio of less than 1 may be due to wasting of muscle or failure to develop.

Skinfold measurements give a measure of subcutaneous body fat and total adiposity. The sites measured are the triceps, abdomen, subscapular and subcostal regions on the left side.

Arm circumference and triceps measurement are used in the calculation of muscle tissue; the measurement of arm circumference itself correlates well with the calculated muscle tissue (Jelliffe, 1966). Mid-upper arm muscle circumference can be calculated in young children with the use of triceps measurement.

There are other anthropometric indices that can be used clinically to assess children, however they probably have limited value in screening for malnutrition in this country since they require more precise training to use and generally show only deviation with marked malnourishment which would already have been evident in height or weight measures.

The recommendations of the 1968 White House Conference on Food, Nutrition and Health regarding body measurements to be done on children are still appropriate (Christakis, 1973, p. 21):

Neonates and infants—weight, recumbent length (crown-heel), head circumference, chest circumference, triceps skinfold.

Preschoolers—weight, standing height, head circumference, chest circumference, triceps skinfold, arm circumference.

Laboratory Data

Hematocrit and hemoglobin determinations are the only laboratory studies appropriate to screening, which is minimum level evaluation (Christakis, 1973, p. 46).

Dietary Data

Specific information on whether fortified and enriched foods are used is a necessary preliminary to diet evaluation and possible vitamin and mineral supplementation of the diet should be included in the assessment. It also helps to know what foods are available locally, as well as the transportation facilities, food patterns, and family buying habits. Attention to the length of time the child spends eating a meal may offer a clue as to the cause of any inadequacy (Seymour, 1969). A knowledge of where the food is consumed (in the home, outside the home, in nursery school, at the baby sitter's, at day care or Head-Start centers, or at school) allows the evaluation of the diet both inside and outside of the home and may help to locate the source of a problem.

The most usual practice for arriving at a nutritional assessment of an individual child is to obtain knowledge of his nutrient intake. For children the following dietary tools are used: the 24-hour recall, the dietary history, and the 3-day record. Each will be discussed individually.

The 24-hour recall is a recall of the food eaten and the eating pattern of the previous 24 hours. The merits and use of this information are open to argument because (a) it represents only one day's food intake out of a lifetime, and (b) intake estimates are based upon memory. The procedure takes about 20 minutes and thus provides an easy screening tool. Nutrient intake is underestimated by this tool, but, because it is short and expedient, it is very popular. Collecting several 24-hour recalls would probably give more assurance of a representative intake than using only one.

The dietary history is a detailed interview with the mother or child who recalls the kinds, amounts, and frequency of foods eaten with the aid of a check list. This method gives an overestimation of nutrient intake because small errors of estimation of individual portions are summated; as a result, if a nutrient appears to be at a low level, it is probably even lower than the history indicates. This tool attempts to discover long-range, retrospective food habits. It is a good clinical tool which takes about an hour to complete. However, it is best used by an experienced interviewer

and cross-checking with the 24-hour recall is helpful, especially with mothers who are not used to observing their children's intake.

The 3-day record of food intake is recorded in household measures by the mother, and accuracy depends upon motivation, intelligence, and cooperation. Errors of estimation are the greatest problem, and this is compounded by the fact that the mother's recording intake may influence what she serves to the child. The 3-day record is used successfully to adjust the diet in regulating the serum phenylalanine level in phenylketonuric children, and it gives a fairly accurate measure of restricted dietary intake when kept by a motivated mother. The record of food intake can be kept for any number of days, and it is assumed that the longer the period of study, the more representative of the actual diet the record will be. But, whether even a week's intake recording gives a valid representation of the diet is unknown. Faced with the factor of cooperation, the 3-day record is considered a good compromise for children.

Clinical Assessment

Behavioral changes in undernourished children are quite apparent to those who have worked with them. They are apathetic, irritable, and readily suffer fatigue. Beyond this, inclusion of clinical signs in a screening type of assessment is not appropriate because malnutrition must be long and severe to produce obvious clinical signs. This occurs very infrequently in the United States (DHEW (HSM) 72–8131, 1972, p. III–1).

The Problems of Prediction

The pathogenesis of severe malnutrition is clear. Both primary and secondary malnutrition follow a common pathway, which toward the end leads to death. But prediction of the effects of mild to moderate malnutrition on the present and future health of the child is not as clear. There are few studies upon which to base a judgment.

The relationship between different levels of hemoglobin, iron, and folic acid to illness and health is not well defined (DHEW (HSM) 72–8132, 1972, p. IV–3). Undernourished children who are unable to respond adequately to environmental stimulation often, but not always, have impaired learning abilities and, if the insult is great and of sufficient duration, growth may be retarded and sexual maturation delayed. The far-reaching effect of stature, as determined by nutriture, on pregnancy outcome has been discussed.

In the past 20 years, attention has focused on the possibility that malnutrition in early infancy and childhood may adversely influence mental and intellectual development. The information has come mostly from animal studies, and transfer of these findings to humans is not valid. In one study on humans, Brown (1966) reported that brains of malnourished children weighed less than those of well-nourished children. In other studies, Stock and Smythe (1967) and Monckeberg (1968), found the head circumference of severely malnourished children to be significantly smaller than that of well-nourished children. This difference was noted as early as the first year of life. And Winick and Rosso (1969, p. 184) showed that children who died in the first year of life of marasmus had a reduced number of brain cells compared to well-nourished children who died of accidents; their findings also suggested that the earlier the occurrence of malnutrition, the more marked the effects. When Chase and Martin (1970, p. 936) correlated the duration of nutritional insult with mental development, they found that children with undernutrition lasting longer than the first 4 months of life were the most severely impaired at age 3.5 years.

The inferences from these findings in terms of human behavior and intellectual functioning are still not clear. The studies of Stoch and Smythe, Monckeberg, and Chase and Martin were confounded by differences in environmental factors (broken homes, alcoholism, unemployment, number of siblings, etc.) that could influence intellectual development. Longitudinal studies are needed to separate parental interaction from social factors accompanying malnutrition.

Whether mild or chronic undernutrition affects intellectual development is also unknown. However, two studies suggest some relationship: Cravioto, DeLicardie and Birch (1966) found that children who were retarded in growth also exhibited a reduced level of neurointegrative competence. Ramos-Galvan et al. (1968) found some indications that, as the nutritional insult is lessened, social, genetic, and other factors play a larger role.

Because nutritional status is affected by factors like poverty, little education, ignorance, and inadequate environmental stimulation, as well as characteristics of the individual, it is difficult to isolate nutrition as a lone variable contributing to the vulnerability of the child. It is important to view the child and his heredity in a dynamic, complex interaction with the environment. Thus, any single characteristic associated with risk is not a good predictor of future health, but a combination of characteristics

or circumstances may well identify a problem. In conclusion, any study investigating the long-term effects of malnutrition will have to be longitudinal and controlled for environmental factors.

78

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Chapter 4

Parents' Perceptions of Their Children

Traditionally, analyses of the environments in which children are raised have focused on two aspects: the amount of physical enrichment, and the characteristics of the interactions between parents and children. But it has been parental behavior toward their children which has been examined, not parental perceptions of their children. Why bother with perceptions? For two reasons. First, the literature on interpersonal perception suggests that parents' perceptions of the child influence behavior in various ways, thus they indirectly influence the child. Most specifically, the parents' perception of the child may have a major impact on the child's self-image concept, since the parents' comments and behaviors to the child are, in the early years, one of his few ways of assessing the impact he has on the world around him (see Meyerowitz, 1967, for a discussion of this). In particular, there is reason to expect that a particularly stressful situation would exist between parent and child if the child's behavior did not match the parents' perception of what an "ideal child" ought to be like (Worchel and Worchel, 1961). Thus for predictive purposes, it is of interest to know something about a parent's view of the ideal child, and his perception of his own child; where these are discrepant, we might expect difficulty.

A second reason for interest in parental perceptions of the child stems from a need to find means of obtaining accurate information about children's development without extensive testing of the child. If parental perceptions of their children are generally accurate, and if they can convey those perceptions with reasonable precision, then it should be possible to use parents' reports as valid assessments of their children, both for research purposes, and for ordinary preventive medical care. The difficulty, of course, is that not all parents will be equally accurate, which raises a related set of questions: (1) Are some kinds of parents more likely to be accurate in their perceptions of their child? (2) What happens in a situation in which the child is perceived to be "better" than he really is, or worse? Does the parent's perception operate as a self-fulfilling prophecy? (3) Which is more difficult for a child, being seen as better than

he is, or being seen as worse? Answers to all of these questions are not available from the current data, but it's worth taking a look at what is known.

Accuracy of Parental Perceptions

Methods of assessing parental perceptions: Simple as it seems, in most cases the technique used to assess the parents' perceptions of their child has been to ask them, with answers guided by some kind of scale. Broussard and Hartner (1971) ask mothers about various characteristics of the "average baby," and then ask about the mother's own baby. For example, they ask, "How much crying do you think the average baby does?" and then give five alternatives: a great deal, a good bit, moderate amount, very little, none. After a series of questions about the average baby, the same questions are asked about her own child. Out of this comes a score which indicates whether the mother, in general, thinks her baby is above or below the average baby.

Other investigators, particularly those working with parents of retarded or physically handicapped children, ask parents to estimate their child's developmental age in comparison to children of the same age (Wolfensberger and Kurtz, 1971; Ewert and Green, 1957; Kurtz, 1965). Accuracy of parental report is ordinarily determined by comparing the parents' ratings or judgments about their child with the ratings or judgments obtained from experts, or with the scores achieved by the child on standardized tests.

Studies of Accuracy

Unfortunately, studies of the accuracy of parental perceptions of their children have been done most often with parents of retarded children. Such information is useful in telling us something about parental accuracy in cases of severe impairment, but may not be generalizable to parents with normal children. The available literature does, however, suggest general conclusions:

1. Parents are, in many instances, quite accurate in their perceptions of their children. For example, Ewart and Green (1957), in a study of 100 parents of retarded children, found that 70 percent of parents' ratings of boys and 57 percent of their ratings of girls were accurate in comparison to assessments made by experts. Kurtz (1965) found a similar degree of agreement between parents and experts, again with parents of retarded children as subjects. The parents' estimates in this study correlated .78 with ratings made by a pediatrician, .63 with ratings made by a speech and hearing examiner, and .74 with ratings

made by a psychologist. Wolfensberger and Kurtz (1971) found that 69 percent of parents' assessments and 75 percent of averaged father-mother estimates of global IQ fell within 15 points of the child's tested IQ, again using parents of retarded children as subjects. It would be erroneous, however, to imply that parental ratings are uniformly accurate; they are more accurate than many experts are willing to credit, but there are nonetheless variations among parents in their degree of accuracy.

2. One of the factors which is related to the degree of accuracy is the level of parental education or social class. Ewart and Green (1957) report that the higher the mother's education, the more accurate she was, while Wolfensberger and Kurtz (1971) report that upper social class parents were more realistic than lower class parents who tended to overestimate their children's abilities. One conflicting piece of evidence comes from a study by Heriot (1967), who used parents of "problem children" rather than of retarded children as subjects. He found only a modest correlation between maternal estimates of the child's IQ and the child's tested IQ (about .50), and did not find that the decree of accuracy was related to the child's age, sex, or the family social class.

3. When parents are incorrect in their perceptions, it is almost always in an upward direction; they see their child as better than he is (Wolfensberger and Kurtz, 1971). In general, mothers are more likely to overestimate than are fathers (Capobianco and Knox, 1964). Kurtz (1965) also reports that the degree of overestimation is related to the degree of the child's retardation: more severely retarded children are *more* accurately perceived. It is the children closest to normal in this study who are most often overestimated, which calls into question the generalizability of results from studies of retarded children to families of normal children.

What all of this adds up to is the conclusion that ordinarily parents can be trusted to recognize a problem in their child when it occurs, although they may tend to underestimate the degree of problem, and overestimate the child's abilities.

But what are the implications for the child of variations in the parents' perceptions? What if the parents are inaccurate? Does this have an impact on the child?

Effects of Parental Perceptions on the Child

The evidence here is scanty but provocative. Only two studies, both very recent, provide any very good information. Greenberg (1971) studied two groups of mothers and children, one in which the child had minor physical abnormalities at birth and the other

in which the child was normal at birth but had serious developmental problems at age 1. When mothers' perceptions of their infants were assessed, Greenberg found that the mothers of the originally healthy infants had strikingly inappropriate perceptions: either they were unaware of any problem in their 1-year-old or saw a problem but greatly underestimated it. These same mothers, in general, had had unplanned symptomatic pregnancies, less education, and had been one of the younger siblings in their own families.

Greenberg's findings are curious in that they suggest a poor outcome for an infant whose mother either does not notice or "denies" the existence of serious problems. Are the child's problems a result of neglect on the part of the mother? Or possibly are the child's problems and the mother's greatly inaccurate perceptions both reflections of a dysfunctioning mother-child dyadic relationship? We can't tell from these results.

Broussard and Hartner's study (1971) is more informative. They began with a study of maternal perceptions of very young infants. Three hundred and eighteen primiparae were asked to rate the "average baby" and their own baby at two separate time points, first, during the first or second postpartum day, while still in the hospital, and second, at approximately 1 month of age. All the infants were initially healthy-appearing. At 1 month, in addition to the ratings of the infant, the mother was also given Schaefer's postnatal research inventory, which yields a set of scale scores, of which six were used: depression, negative aspects of child rearing, irritability, need for reassurance, fear or concern for the baby, and mother's psychosomatic symptom anxiety.

At the time one assessment, i.e., done right after birth, 46.5 percent of the mothers rated their infants as better than average, but these ratings did not correlate with Schaefer's scale scores. At time two, i.e., at 1 month of age, 61.2 percent of the mothers rated their infants as better than average, and their perceptions of the infant were correlated with Schaefer's scale scores. Those mothers who rated their infants as below average were significantly more likely to rate high in depression, irritability, and negative aspects of child rearing.

Broussard and Hartner (1971) considered that a mother's low rating of her infant combined with maternal depression and irritability might well bode ill for the child's later emotional development. The 1-month findings suggested that some of the mothers and infants had already established poor dyadic interactions; prolongation of such a relationship might well produce emotional disturbance in the child at a later point.

To test this possibility, Broussard and Hartner divided their original sample into "high-risk" and "low-risk" infants on the basis of the mother's evaluation of the baby at 1 month. Those who had been rated by their mothers as above average at 1 month were considered at low risk for later psychiatric disorders, while those who had been rated by their mothers as below average at 1 month were considered at high risk for later psychiatric disorder. Eighty-five of the children were then followed until they were approximately 4½ years old, at which time an independent assessment of their psychiatric status was made. The clinical judgments were made by people who did not know whether the children had been rated as high or low risk initially. Each child was rated by the clinician as needing or not needing therapeutic intervention at age 4½. The results are suggestive: the mother's perceptions of the child at time one (at birth) did not predict the later need for therapeutic intervention, but her perceptions of the child at time two (1 month) did. Sixty-six percent of those in the high-risk group were seen at age 4½ as needing therapy while only 20 percent of the low-risk group were seen as requiring help at age 4½. In addition, the scores on Schaefer's postnatal research inventory, taken at 1 month, also predicted the need for intervention at age 4½: those mothers who were depressed showed psychosomatic anxiety symptoms, and reported negative aspects to child rearing 1 month after the birth of the child were more likely to have a child at 4½ years who was perceived as needing psychiatric attention.

The need for intervention at age 4 was not related to the mother's education, the father's occupation, changes of income, prenatal or postpartum complications, type of delivery, age of mother at delivery, or sex of the child. The lack of a relationship between 4½-year-old status and maternal education, in view of all the other evidence relating mother's education to later child outcomes, is of considerable interest. The finding suggests, as was emphasized in the introductory section of the monograph, that it is not education per se which is crucial but rather maternal behavior. What Broussard and Hartner have pointed to is one aspect of maternal behavior which may be of importance.

It should be noted, however, that from Broussard and Hartner's results we can sort out two possible interpretations of the findings. First, it may be that, at time two (1 month), mothers have correctly perceived the degree of difficulty their infants have: the low-rated infants may really have more problems and may turn out to have more problems later, not because of anything the mother did, but because of some inherent difficulty not

assessed at birth. Alternatively, the mother's perceptions at time two (1 month) may operate as a self-fulfilling prophecy: those mothers who see their infant as better than average will continue to treat the child as better, will generally have an optimistic view of the child and the child's future, and will develop a positive interaction with the child, leading to good mental health; those mothers who see their child as below average will continue to see the child as subnormal, will treat the child as such, and will have (or develop) a pessimistic attitude toward the child and toward their ability to cope. Without an independent assessment of the children, it is difficult to select from among these alternatives, although the fact that at 1 month postpartum, the mother's emotional state was related to her perception of the infant lends some weight to the second alternative.

The results from the Greenberg, Broussard, and Hartner studies are intriguing, even though they raise more questions than they answer. The suggestion is there, however, that the parents' perceptions of the child *may* act as causal agents in the child's later development, particularly in the child's emotional development. This possibility is surely worth extensive further study.

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Chapter 5

The Animate Environment

Concern for the quality of the environment in which children are raised has, one supposes, always been present to some extent. But such concern was greatly accentuated in this country with the publication of John Bowlby's monograph (1951), prepared for the World Health Organization, in which he discussed the impact of institutionalization on children. Bowlby reviewed the several studies (including those by Spitz, Goldfarb, and others) which appeared to show that the conditions in most institutions were seriously detrimental to the emotional and mental health of the children reared there. In particular, the lack of a single mother figure was cited by Bowlby as the critical flaw, although the institutional environments also lacked sufficient perceptual and motor stimulation. Regardless of which particular feature of the environment was considered as crucial, the fact remained that, as a result of rearing in this very grossly deprived environment, children appeared to be very markedly retarded in mental development, in language, and in development of normal interpersonal attachments. The next legitimate question was whether milder forms of the same kind of deprivation would result in milder forms of retardation.

A second line of research, very nearly coinciding with Bowlby's monograph and the work growing out of it, was provoked by Hebb's neuropsychological theory of development (1949). Very generally, Hebb proposed that during the early months or years of life a variety of perceptual experiences is required in order for the organism to build up the associative base on which later more complex cognitive operations may be founded. One of the testable hypotheses growing out of Hebb's theory was the expectation that perceptual deprivation should lead to permanent disabilities in learning. A whole series of experiments was done with animals in an effort to test this assertion. On the whole, although the findings did not always support the specifics of this theory, they have supported Hebb's general contention, namely that early perceptual or experiential deprivation does result in a kind of retardation of later learning. At least this is true for species such as the rat, the dog, and the monkey (see

Scott, 1968, for an extensive review) and, by extrapolation, it is probably true for man as well.

These two lines of work seemed to fit neatly together, since the institutional circumstances appeared in some ways to parallel the deprivation conditions in the animal experiments. Together, they added up to a clear emphasis on the importance of the postnatal environment for determining cognitive development and probably for emotional development as well.

Yet a third source of the current emphasis on the environment has been the accumulating evidence from short-term longitudinal studies such as the Smith, Flick, Ferriss, and Sellmann (1972) and Willerman, Broman, and Fiedler (1970) studies, discussed in other papers in this monograph, in which the role of the environment seems to be a crucial modifier of the effects of initial physical or developmental status.

For all of these reasons, it seems to be of particular importance to be able to evaluate the impact of the environment in general, and of specific features of the environment in particular, on child development. But to talk about the environment is obviously much too global. How is one to conceptualize all the environmental forces? How can they be separated out so that they may be studied independently?

Conceptualization of the Environment

Several conceptual systems have been suggested. Maas (1971) distinguishes between immediate or "proximal" environments and remote or "distal" environments. The former includes the family and home surroundings of the child while the latter includes, for example, the social class of the family or the culture of poverty, which may be somewhat but never completely mediated by the child's family or caretaker. This is a useful distinction but still leaves all the normal, day-to-day stimulation the child receives in one large lump. Some further subdivision of experience seems necessary.

Barnett (1972) has offered a considerably more complex categorization consisting mainly of a distinction between the natural environment, which includes physical and chemical influences and geography, and the man-made environment, which includes the family, community, nutrition, education, buildings, etc. The system of conceptualization, preferred by this author, is the one offered by Yarrow and his associates (Yarrow, 1968; Yarrow, Rubenstein, Pedersen, and Jankowski, 1972). He distinguishes between the "animate" and the "inanimate environment," where the inanimate environment is evaluated in terms of the variety,

responsiveness, and complexity of the objects and stimuli available to the child for exploration and manipulation. The animate environment includes the activities of the caretaker, not only physical contact with the child but also the use by the caretaker of all the various dimensions and modalities in arousing and directing the attention of the young child to the external environment.

Obviously the animate and inanimate environments overlap somewhat, since the caretaker may provide inanimate stimulation as part of an effort to evoke response or learning from the child. In such a circumstance, Yarrow considers that the stimulation is primarily animate, since it originated from the caretaker. In essence, then, animate stimulation covers all experiences encountered by the child which originate with or evolve directly from the caretaker (or other people). Inanimate stimulation covers the characteristics of the physical world itself: the richness and variety of experiences which are available to the child when the caretaker is not present or is not providing stimulation.

In this chapter, only the literature relevant to the animate environment is discussed; the inanimate, physical environment is covered in the next chapter of this review.

The Interactive Nature of the Animate Environment

In Yarrow's definition of the animate environment, it is implied that the source of the animate interaction is always the caretaker, e.g., caretaker stimulates the child, organizes his experiences, provides opportunities for learning, etc. But, of course, the relationship between caretaker, usually the mother, and the child is not unidirectional. The child responds to what is done and offered, and that response in turn affects the way in which adults approach the child in the future. The child, too, initiates interactions, by demanding attention, by being quiescent, etc. So in order to understand the impact of the animate environment, it must always be considered as an interactive process with each of the participants bringing to the interaction some habits, emotional patterns, and individual reaction tendencies. The mix of the two sets of habits and patterns in turn affects the behavior of each, until the two together work out a new set of patterns and habits. In order to examine this meaningfully, it is helpful to begin by examining what each of the participants brings to the situation and by considering how these initial differences affect the interaction.

What the child brings to the interaction: In order to determine just how different infants are at birth, Korner and Grobstein (1967) studied a group of 43 1-day-old infants, all of whom were in good physical health at birth. Each baby's responses to visual,

auditory, textural, and tactile stimuli were assessed, along with the clarity with which the infant conveyed hunger and fatigue, and the degree to which hunger tension disorganized the infant's behavior, and the differences in psychosexual disposition displayed by the infant's mouthing, spitting, vigor of suck, defense against noxious stimulation, irritability, soothability, quality and quantity of movement, and sleep patterns. The most consistent individual differences were of three kinds. First, there were marked differences in the frequency and length of visual alertness episodes. Because visual prehension is one of the few means the neonate has at his disposal to make contact with and take in the environment, those infants capable of periods of sustained alertness have earlier and more frequent opportunities to learn and to acquaint themselves with their surroundings. Second, the infants differed markedly in soothability and this difference was found to have differential effects on the mother's feelings of competence and relatedness to her infant. Those mothers with the most soothable infants more quickly felt competent and related to the baby. Third, there were differences in the apparent intensity of the oral drive and in the quality of oral behavior. Some infants with diffuse bodily activity rarely succeeded in establishing hand-to-mouth contact, in contrast to slowly moving and better coordinated infants, who were frequently able to establish hand-to-mouth contact.

Thus, on the first day of life there are already quite clear differences among babies, and on dimensions which will surely affect the child's interaction with both the animate and inanimate environment.

Bridger and Birns (1968) similarly found consistent differences in "temperament" in babies during the first days after birth. In particular they found that babies differed in their response to novelty (some indifferent, some alert, some distressed) and in the vigor of their response to various kinds of stimulation.

Brazelton (1971) has perhaps gone farther than any other investigator in identifying the dimensions on which infants differ initially. He has devised an assessment procedure, to be administered during the first to third day of life, which explores the infant's response to 27 different events or stimuli. From these measures it is possible to evaluate the infant on such dimensions as activity and reactivity levels, consolability, irritability, cuddliness, responsiveness to sensory stimulation, and others. Brazelton finds that the scores from the assessment obtained at birth are moderately consistent over the first month of life, suggesting

that the very early individual differences are indeed stable personal characteristics.

Similar infant differences were found by Thomas, Chess, Birch, Hertzig, and Korn (1963) who note consistent and persisting individual infant differences on feeling mood, style of concentration, and intensity of reaction to novel experiences.

There is also some evidence that sex of the infant may be one factor affecting the particular style of behavior shown by the infant. Moss (1967) reported that boys are more subject to inconsolable states and more vulnerable to adverse conditions than are girls, possibly indicative of less well organized physiological reactions. However, Korner and Thoman (1970) did not find such a sex difference. The disparity in findings may be explained by the fact that Moss' study was done with older infants, while Korner and Thoman studied newborns, although why male infants should become more inconsolable by 3 weeks of age is not clear.

Korner (1973) has reviewed all the evidence on sex differences in neonates and lists the following specific differences: females are more responsive to cutaneous stimuli, to electroactual stimuli, to photic stimuli, and to the taste of sweetness. They also show more rhythmical mouthing, reflex smiling, and are more mouth-dominated than males. Males may, from birth, have greater physical strength or muscular vigor. The evidence on rate of activity and on amount of visual alertness are equivocal.

It should be obvious from this very brief review that infants do differ from birth, in important ways. In some instances, the differences may be related to the sex of the child, in others, quite unrelated to the child's sex. In either case, the child enters the interaction with the mother or other caretaker with definite patterns already established, and those patterns will in turn affect the way in which the mother responds to the infant. By 3 weeks of age, clear reciprocal relationships have already begun to be established (Moss, 1967), with mothers responding differently to crying or inconsolable infants and to infants who are quieter or more consolable.

What the mother brings to the interaction:[1] The mother, or other caretaker, brings to the interaction a whole host of already existing patterns, attitudes, and expectations. The mother's personality, her general degree of vigor or passivity, her positive or depressed attitude toward her own life, the degree of turmoil and

[1]Here and elsewhere in this review we have talked about "mother-child interaction," as if the mother were the only critical adult. We should emphasize that all caretakers and all other adults are important, though the mother is usually the most frequent and hence the most crucial one.

crisis in her life, her physical health, and her attitudes toward the infant all affect the manner in which she will approach the interaction with the child. In chapter 4, we have presented in detail the evidence on the impact of maternal perception of the child on that interaction. Such perceptions, either of the infant after birth or expectations about the infant before birth, may well have a profound effect on the interaction between the two. But there are other influences as well.

The mother's level of education (or her social class—the two are related) has been found to be correlated with a host of variables relating not only to typical styles of interaction with infants but also to expectations about infants. For example, Kilbride, Johnson, and Streissguth (1971) reported that in their sample of well and less well educated mothers, 70 percent of the well educated mothers said they thought that infants began learning and seeing as soon as they were born, while only 25 percent of the less well educated mothers thought that infants could learn that early, and only 37 percent thought they could see at birth. Such differences in assumptions about the capabilities of infants may well be a direct result of differences in education; but, regardless of their origin, they undoubtedly have some effect on the manner in which the mother responds to her infant and the kind of environment and stimulation she provides for him.

Hess and Shipman, in an extensive study of a group of black mothers, have reported that the mothers of varying social class differed consistently on a number of dimensions of behavior with their children (Hess and Shipman, 1965, 1967, 1968; Hess, Shipman, Brophy, and Bear, 1969). For example, middle-class mothers more often gave rationales with their instructions to their child, used more praise, oriented the child to a task with more care, and gave more helpful specific feedback to the child about the correctness of his actions. In addition, the mothers differed on a pervasive dimension of style. Lower class mothers, usually less well educated, more often used what Hess and Shipman have called an "imperative" style, one in which the mother controls the child's behavior through appeals to social norms or to power and authority ("You'll do that because I say so" or "Teachers don't like children who do that"). Middle-class mothers, usually more educated, were more likely to use either the "personal-subjective" style in which the mother appeals to feelings, preferences, or personal considerations (e.g., "You hurt your sister's feelings when you say things like that"), or a "cognitive-rational" style in which the mother explains the consequences of the child's

actions or emphasizes a long-term goal or gain, or explains the reasons for a rule or a demand.

Bee, Van Egeren, Streissguth, Nyman, and Leckie (1969) found similar differences in a study involving both black and white mothers and children. The middle-class mothers were less critical, more positive, less likely to intrude on the child's activities, and more likely to phrase suggestions to the child as a question, rather than as a command.

It should be emphasized, however, that in both Hess and Shipman's work and in the Bee et al. study, the mothers studied were interacting with their 4-year-old children. So it is not possible to determine whether the style differences are the result of tendencies the mother brought with her into the interaction with the child from the first day, or whether they are, in part, a result of the interaction between herself and the infant over time. Some evidence that the same style differences are present in the early months with the child comes from a similar study with 9-month and older infants by Streissguth and Bee (1972). They found that mothers, in interacting with their infants as young as 9 months of age, showed the same sort of education and social class differences that Hess and Shipman, and that Bee et al. had found in mothers interacting with their 4-year-olds: better educated mothers used more praise, less criticism, and oriented the infant more carefully to the task to be presented.

There is other, equivalent evidence suggesting that the mother's level of education is quite highly correlated with a whole range of child-rearing variables (see Chilman, 1966, for a review) although in most instances we do not know whether the mother's style and assumptions about the child were present before the birth of the child, or whether her style of interaction developed as a result of her encounters with the child after birth. It is hard to believe that it could be the latter, however, since there is very little indication that the infants born to less well educated mothers are systematically different from those born to better educated mothers; so although each individual infant will bring his or her own separate response tendencies, the infants of less well educated mothers as a group are not similar. All of which makes more tenable the assertion that the well and less well educated mothers differ from the very start in style of interaction, control techniques, and assumptions about the child's capabilities.

One study which explored the mother's behaviors and attitudes before the birth of the child, and then followed the mother-child dyad through part of the first year, has been reported by Moss, Robson, and Pederson (1969). They studied 54 primiparous moth-

ers and infants, beginning with an interview with the mother during the last trimester of pregnancy. The mother and infant were then observed in the home after the first month, and again at the end of the third month. The maternal variable derived from the prenatal interview, which was explored in this study, was the "mother as a source of stimulation." The authors rated the mother's voice quality during the interview, based on the degree of animation, rapidity, excitement, and modulation of the voice. "The assumption was that the speech behavior of these women would index their overall expressiveness and predisposition to emit stimulation to those around them" (Moss et al., 1969, p. 240). When the mother's behavior toward the infant at 1 month and 3 months was related to her rating on voice quality, they found that the most animated mothers were more likely to talk to their 1-month-old sons and more likely to kiss and rock them. For female infants, there were no relationships at 1 month, although by the time the infant girls were 3 months old, the more animated mothers were providing more auditory stimulation to their daughters. Thus a simple rating of one aspect of maternal behavior, assessed before the birth of the child, has at least some predictive value in forecasting the mother's behavior with her infant after birth.

In addition to the mother's typical style (such as her voice quality), or her enduring personality characteristics which will affect her interaction with her infant, there are also some more short-term influences on the mother which may well have an impact on her ability to cope with the new child. For example, Holmes and his associates (Holmes and Rahe, 1967; Rahe, 1969; Rahe, Meyer, Smith, Kjaer, and Holmes, 1964; Holmes and Wolff, 1952; Ruch and Holmes, 1971) have developed a procedure for assessing the degree of life crisis faced by any individual, where the total life crisis is taken as the sum of a whole series of small or large changes or readjustments occurring in the subject's life over a short period of time. Holmes has found repeatedly that those individuals undergoing moderate or major life crises are substantially more likely to experience physical illness, or emotional disturbance, such as severe depression. While there is no study at present relating the degree of life crisis and the mother's experiences during pregnancy and immediately thereafter, there is every reason to suppose that major life crises, occurring during the pregnancy, or shortly thereafter, will affect the mother's health, and her emotional stability. Thus a mother who experienced a major crisis or an accumulation of smaller crises during

her pregnancy brings to her interactions with her child all the buildup of tension which is attendant on such life crises.

The Effect of Interaction Patterns on the Child's Development

It is clear from these reports of the infants' and mothers' contributions to their interactions that each of the two brings long-term predispositions, as well as momentary habits or moods to the interaction, and that what they build together is a function of, but not the sum of, these individual contributions. Mothers and infants do build very different sorts of patterns of interaction with one another: some infants receive a lot of cuddling, verbal stimulation, and affection; others are given lots of toys and objects but not much physical contact; some get little of either. What are the effects of such variations on the child? Can we trace different outcomes for the child to differences in early interaction patterns?

Three sorts of research may be brought to bear on these questions. First, there are the experimental studies, in which infants have been provided systematically with various kinds of extra stimulation in an effort to see the effect of such stimulation on the child's development. Ottinger, Blatchley, and Denenberg (1969), for example, provided one group of neonates with extra tactile and kinesthetic stimulation during the first 3 days of life. On the fourth day the stimulated subjects were observed to spend more time with their eyes open and had a higher fixation rate to a visual target than did a group of unstimulated infants. These findings suggest at least the possibility that the degree of richness and intensity of tactile and kinesthetic stimulation may affect the rate of the child's development of visual skills and possibly attention. In other studies of the same type, White (1967) has shown that extra handling during the first month of life increased visual attentiveness in a group of institutionalized infants; Rheingold, Gewirtz, and Ross (1959) increased the vocalizations of 3-month-old institutionalized infants by providing brief multisensory stimulation for several days; and Korner and Grobstein (1966) demonstrated that holding an infant at the shoulder, rather than propping the baby up or leaving the child lying in a crib, increases the amount of visual alertness shown by the infant.

Such experimental studies certainly provide support for the general contention that the variety and amount of stimulation provided to the infant affects the infant's development, and in addition, give some clues about the dimensions of stimulation which may matter. But they do not tell much about the naturally occurring caretaker-child interactions and their effects.

Another type of evidence comes from studies in which mothers have been observed directly with their children and the children's behavior assessed separately. One of the best such studies is an investigation by Rubenstein (1967), who examined the mother's attentiveness toward her infant and related this to the child's degree of exploratory behavior some months later. She assessed the mothers' attentiveness when the infants were 5 months old, on the basis of a 3-hour home observation in which the mothers were scored for the proportion of time they spent looking at, talking to, touching, or holding their infants. When the infants were 6½ months old, they were presented with a series of novel toys and their degree of exploratory behavior assessed. Rubenstein's findings indicate that those infants with the most attentive mothers at 5 months were the most exploratory at 6½ months.

Concurrent relationships, as opposed to the longitudinal relationship shown in Rubenstein's study, between infant behavior and skills and maternal stimulation are demonstrated in an excellent study by Yarrow, Rubenstein, Pedersen, and Jankowski (1972). They studied a group of 5-month-old black infants and their mothers. Each mother-child dyad was observed in the home for a total of 6 hours, during which time the observers assessed the level and variety of social stimulation, along with the degree of positive affect, and the mother's response to the child's vocalizations and to the child's distress. They also scored the inanimate environment on the dimensions of responsiveness, complexity and variety. The infants were separately examined, using the Bayley Scales of Infant Development and the measure of exploratory behavior used by Rubenstein in the earlier study. They found that, in general, the more variety of social stimulation, the more positive affect shown; and the more rapid the mother's response to the infant when he showed distress, the more rapid the infant's development on the Bayley scales. In particular, the child's goal-directed behaviors were heavily affected by the richness of social stimulation, as was the infant's social responsiveness and, to a lesser extent, his early language. The richness and variety of inanimate stimulation, on the other hand, had little effect on the infant's social responsiveness and had no effect on his language; but it did have a considerable effect on his goal-directed behaviors, conceptualized as early cognitive functions. Thus the animate and inanimate stimulation, while both having an effect, have somewhat different outcomes.

Hess and Shipman, too, have found relationships between maternal behavior and the child's functioning (Hess and Shipman, 1965, 1967, 1968; Hess, Shipman, Brophy, and Bear, 1968,

1969). They have found that those mothers who use the most effective teaching strategies with their child in structured teaching situations have the most intellectually mature children. Furthermore, the mother's teaching style with the child when the child was 4 years old was predictive of the child's performance in first and second grade.

In one of the few studies to examine an outcome other than the child's cognitive functioning, Moss, Robson, and Pederson (1969), in the research described earlier, have found that those infants whose mothers provided the most visual and auditory stimulation at 3 months of age were the least likely to show fear of strangers at 8 months. Thus the level of stimulation seems to have an effect not only on the child's development of the early cognitive functions, but may also have a general effect on interpersonal relationships as well.

A third, quite different way to go about studying the impact of the environment of the child's functioning is to attempt to change the mother's or caretaker's, behavior and then to assess the impact of the change on the child. Quite a number of such attempts have been made with preschool age children, in each case with the intent of improving the child's cognitive functioning. For example, Levenstein (Levenstein and Sunley, 1968; Levenstein, 1970) has worked with a group of mothers of 2-year-old infants. A "toy demonstrator" is sent into each home on a weekly basis. She brings with her a set of toys which have been designed to provide a rich variety of stimulation for the infant, shows the mother how to use the toys in play with the infant, and encourages the mother to interact with the child. After 7 months of such visits, the children in the experimental group showed an average IQ gain of 17 points, while the control group showed a gain of only two points. Levenstein also included a second control group who were visited and were given gifts, but were not given specifically stimulating toys, nor were the mothers encouraged to play with their children. This second control group showed an average IQ gain of only two points, indicating that the effect observed in the experimental group was specific to the toys and the hopefully increased interaction between the mother and the infant.

Karnes, Studley, Wright, and Hodgin (1968) have used a somewhat different procedure. Rather than going into the home and working with the mother and the child, they bring a group of mothers together for sessions in which new toys are constructed, the use of the toys discussed, and the mothers' problems with their children, the children's responses to the previous week's toys, etc. are explored. Over 11 weeks of once-a-week sessions with the

mothers, the children of the experimental group showed an IQ increase of approximately 7½ points, while the control group showed essentially no gain.

The problem with intervention studies of these types is that they do not tell what specific aspects of the mother's behavior are crucial. We don't really know what behavior has been changed; all we know is that the child's test performance has been altered, but this sort of design will not tell us what it was that the mother did, or did not do, that helped bring about the change. Still, such intervention studies are of considerable interest, not only because they lend support to the very general hypothesis that the interpersonal environment has a casual effect on the child's cognitive, and possibly emotional, development, but because they suggest the potential for change in the mother's behavior. From the point of view of one interested in identifying children who are at high risk of poor intellectual or emotional development, there is little help in being able to identify the casual factors unless some remediation is possible. Intervention studies like Levenstein's and Karnes et al.'s, suggest that maternal-child interactions are maleable.

Obviously the available research is only a set of fragments, in part because we are only beginning to learn the appropriate dimensions of the environment to study, and in part because good research of this type is extremely complex and time-consuming. But the existing fragments all appear to indicate that there are not only general effects of the amount of stimulation provided to the infant, but probably very specific effects as well, with particular kinds of combinations of stimulation having very predictable effects on the child's skills and behaviors.

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Chapter 6

The Inanimate Environment

In the introduction to the preceding chapter on the impact of the animate environment, the case was made for the importance of examining the environmental influences, and for the division of the discussion into two parts. The animal literature, as well as research on institutionalized infants, persuades us that the inanimate environment, as well as the animate, is of importance in the child's development, particularly of cognitive and perceptual skills.

How can the inanimate environment be conceptualized? Or, put another way, what do you measure when you assess the inanimate environment? Or what do you vary if you are attempting to manipulate the inanimate environment? By far the most common way to assess or manipulate the inanimate environment has been to examine or vary the sheer quantity of stimulation. In the animal literature on the effects of deprivation, the majority of studies has varied the amount of stimulation, rather than its quality, complexity, or some other variable. While the results of such studies suggest that variations in the total amount of stimulation available do make a difference, this does not tell us much about the variety, or complexity, or the timing of stimulation, any or all of which might be equally important.

Yarrow, Rubenstein, Pedersen, Jankowski (1972) have offered what seems to us to be a much more fruitful approach. They divide the inanimate environment into three dimensions: (1) variety: the number of different objects available to the child, (2) responsiveness: an index of the feedback potential inherent in objects, and (3) complexity: the extent to which objects provide information through various modalities. Clearly, it is possible for one home environment to be high in variety, but low in responsiveness or complexity; or the environment may be high in complexity, but low in variety, and so forth. The finer analysis made possible by this conceptual system may tell us more precisely what it is about the inanimate environment that matters in the child's development.

Since the older literature, however, is heavily based on an "amount" conceptualization of stimulation, let us examine the

evidence on the impact of variations in amount of stimulation first, before going on to a brief examination of the evidence on the impact of variations in complexity, variety, and responsiveness.

Amount of Stimulation

The animal literature: There has been a massive amount of research on the effect of variations in stimulation on early development in other animal species, with most work being done with rats, monkeys, and dogs (see Thompson and Grusec, 1970, for an exhaustive review). Several conclusions seem warranted on the basis of this voluminous research:

1. Some basic minimum amount of handling stimulation is required during early infancy to stimulate the growth of the endocrine system and, hence, to foster optimum physical growth and optimum adaptation to novel environments later (Levine and Mullins, 1966). But in this particular train of research, the findings clearly indicate that the basic minimum—at least for rats—is very minimal indeed. Whether any human infants receive so little stimulation as to fall below the minimum is doubtful.
2. The effect of handling is much greater during the neonatal period in rats, which corresponds to about the first month of life in the human infant (Denenberg, 1967).
3. Rearing in a restricted stimulus environment, compared to rearing in an enriched stimulus environment (e.g., a "rat Coney Island") affects later learning ability of the animals; those reared in the restricted environment are particularly incapacitated in learning situations which require adaptation to new circumstances (Forgays and Read, 1962). Further, the positive effect of the enriched environment is greater when the rat is exposed to it immediately after weaning; earlier or later enrichment, while having a positive effect, is not as conducive to good learning.

Obviously, extrapolating directly from the animal research to the situation of the human child has its considerable dangers. But the animal research does suggest strongly that the sheer amount of stimulation may have an effect, and that the timing of the stimulation may be of particular importance.

The studies of institutionalized children: The early research on institutionalized children (Spitz, 1945, 1946, and Bowlby's 1952 review of all the early work) focused attention almost exclusively on the lack of animate stimulation in institutions then extant. The equally obvious lack of inanimate stimulation was seldom mentioned and seldom studied directly. More recent studies have focused on the inanimate stimulation as well as the animate.

Dennis (1960), for example, studied three institutions in Iran, two of which were very low in inanimate stimulations and one providing much richer stimulation. In the first two institutions, the infants had no toys, were seldom placed in a prone position, were not assisted to sit, nor provided with opportunities to play with each other. In the third institution, there were toys provided, the children were propped in a sitting position if not able to sit alone, they were placed in playpens after 4 months, and had contact with one another. The results of comparisons of these children in motor development clearly indicates massive retardation in motor skills in both institution 1 and 2, with less marked retardation in the third institution. No assessments of early mental development were made; so there is no way of knowing whether comparable differences would be found.

In a quite different study of institutionalized children, Burton White (1967) specifically varied the amount of visual and tactual stimulation provided to infants from 1 month through 4 months of age. In general he found that the infants who were provided with extra visual stimuli, such as crib sheets with pictures, mobiles above the crib, and crib bumpers with pictures, and who were exposed to extra tactual stimuli, such as being carried by a nurse, showed more rapid development of some kinds of attentional behaviors, such as visually directed reaching, than did the infants who were not provided with the extra stimuli. There were, however, indications that too much stimulation could be provided. One group, which White calls the "massive enrichment" group, was slower to develop visual attention skills than a more modestly stimulated group, although both were faster than the nonstimulated group. This suggests that overstimulation is possible as well as understimulation.

Noise research: Other evidence on the possibility of overstimulation comes from two very different sources. First, there is recent research out of Japan (Yoichi and Hattori, 1971) that excessive noise during the last 4 months of a pregnancy substantially increases the likelihood of premature birth. In this instance, all the subject mothers moved near a major airport after the fifth prenatal month, and were thus exposed to frequent high decibel noise. Not only were they likely to give birth prematurely, but they reported that the infants, even if born at full term, were fussier, more reactive to environmental noise, and cried more than did babies not exposed prenatally to such high noise levels. What is lacking in this research is direct observation of the infants and some followup with measures of motor, perceptual, and mental development, which might tell us the long-term outcome. Also

lacking is a comparison of infants who had experienced noise prenatally, but not postnatally, with groups who had had both, neither, and alternate experiences. Nonetheless, the Japanese research alerts us further to the possibility that excessive stimulation may have detrimental effects.

Another study which also points to the possibility of overstimulation, has been reported by Wachs, Uzgiris, and Hunt (1971). They examined babies of 7, 11, 15, 18, and 22 months of age, half from poverty homes, half from middle-class homes. The infants' mental development was assessed with the Infant Psychological Development Scale, a Piegetian-style measure of early cognitive functioning (discussed in chapter 11 on mental development), while the environment was assessed on the basis of a home visit, using an early version of the Caldwell Home Inventory for Infants. The Caldwell included, at that time, 72 items about the physical circumstances of the home, the amount of animate and inanimate stimulation, the child's daily routine, and so forth. The home visitor scores each item on a two point scale (present or absent) on the basis either of direct observation or conversation with the primary caretaker, usually the mother.

Wachs et al. reported that several of the items from the Caldwell that appear to assess the amount of inanimate stimulation were significantly negatively correlated with the child's rate of cognitive development. For example, at 7 months, those infants in homes rated as having a high sound level and a high level of activity were slower in cognitive development than infants in less noisy and less active homes. Similar relationships were found at 11 months, and at 15 and 22 months. Such findings again suggest the possibility that a high amount of stimulation is not necessarily a good thing. But there were some puzzling correlations as well. They also found negative correlations between the child's cognitive development and the number of visits to neighbors or of visits outside of the child's neighborhood and these are experiences we would ordinarily consider as opportunities for variety and enrichment. What is lacking in understanding these findings is any information about the circumstances under which the visits take place. Is the child awakened from a nap to be taken next door? Is the child prepared ahead for a visit away from home? Is the child provided with toys and objects when visiting away from home? Since the information about visits was based solely on mothers' reports, we have none of this useful, ancillary information and, hence, cannot make much sense out of some of the findings.

The conclusion reached from the varied sources of research

discussed here is that the total amount of stimulation does matter, but that we are dealing with a continuum in which optimum levels of stimulation lie in the middle. Too much, or too little stimulation can be equally detrimental.

But this does not describe what the characteristics of "too much" or "too little" stimulation actually are for the human infant. Yarrow's finer analysis gives promise of clearer answers.

Variety of Stimulation

Of concern here is the number of different things available to the infant, not the total number of stimulus events. Thus a child who hears television most of the time may have a high amount of stimulation, in total, but that stimulation is of low variety.

The best source of information about the effect of variety of stimulation on the child is from Yarrow's research (Yarrow et al., 1972) in which this variable was specifically examined. A total of 41 mother-infant pairs were observed for a total of 6 hours of home observation. Variety of stimulation was measured as the total number of different objects within reach of the infant during the 6 hours of observation. Yarrow and his associates also assessed the infants separately, using the Bayley Scales of Infant Development (see chapter 11 on mental development for a discussion of this scale), as well as a measure of response to novelty developed by Rubenstein (1967). The Bayley was scored not only for total scores on mental and motor development but also sub-scored in the additional areas of: language, social responsiveness, goal-directed behaviors (including goal orientation, reaching and grasping, and secondary circular reaction), cognitive functions (problem solving and object permanence), and exploratory behavior (from the Rubenstein procedure).

When the scores of the environmental variety were correlated with the scores obtained by the infants on the Bayley, and on the test of exploratory behavior, some striking relationships emerge. Variety of the environment did not predict the infant's social responsiveness or language development. But it did correlate quite markedly with motor development, goal-directed behaviors, cognitive functions, and exploratory behavior. The highest of these correlations is between variety of stimulation and problem solving in the child: $r = .50$. Other correlations were in the .40's and .30's. Overall, it seems clear that in this study, those infants who had the most varied environment available to them were the most developed cognitively, and the most curious and exploratory. Such a finding is consistent with several theoretical views, as Yarrow et al. point out:

> Piaget emphasizes that assimilating and accomodating to varying properties of objects is instrumental in differentiating basic schemata. Variety may also affect the arousal level of the infant, keeping him alert and ready to 'tune in' to the environment (Schaffer and Emerson, 1968); and it may lead to an adaptation level (Helson, 1964) for more novel input, strengthening the infant's motivation to maintain high degrees of variation in stimulation (Yarrow et al., 1972, p. 215).

Please note that there is enough variation in stimulus variety in an ordinary set of families to produce the effect of adequately motivating the child to learn. It has sometimes been argued that "stimulus deprivation" only had a negative effect if it were extremely severe; that in a normal range of home stimulation all homes would be above some needed threshold of stimulation. The finding of Yarrow et al. indicates that finer gradations of stimulus variety also make a difference and at as young an age as 5 months.

Although no other study was found which has a similarly distinct measure of variety of stimulation, there is some additional supporting evidence from studies in which the Caldwell Home Inventory for Infants has been used as an assessment of the environment. Wachs, Uzgiris and Hunt (1971), mentioned before, correlated the scores on individual items on the Caldwell with infants' performance on their own test of "Piagetian style" mental development. They found the Caldwell items which appear to have to do with the variety of stimulation, such as availability of books or magazines within reach of the child, brightness and distinctness of colors in the home, or the amount of furniture in the home, all correlate positively with the measures of cognitive functioning.

Responsiveness of Environment

Yarrow et al. again offer the only data directly related to this question. They assessed the responsiveness of the environment by scoring, for each toy available to the child, the number of moving parts, the changes in shape and contour possible, and the noise production of the toy. The score used is the average responsiveness across all the child's toys.

In this measure emphasis is placed on toys or objects that change as a result of some action on the part of the child and thus may affect the child's sense of mastery in exploration and may also begin to teach means-ends relationships: if I turn this, it moves. In fact, the responsiveness score correlates with precisely those test scores which reflect mastery of exploration and rudimentary beginnings of means-ends relationships. Responsiveness correlated .51 with the measure of "secondary circular reaction," which

involves the repetition of behavior that produces interesting results and which Piaget sees as a precursor to the later development of full means-ends relationships. Yarrow et al. (1972, p. 213) say: "Our findings suggest that the responsiveness of objects in the infant's natural environment may facilitate both motivational and skill components of development."

Complexity of Environment

The third of Yarrow et al.'s dimensions of environmental stimulation is complexity. This factor refers to the extent to which objects provide information through several modalities. Each toy available to the child was scored on number of colors, variation in contour, amount of visual and tactual pattern, size of object and extent of responsiveness. Obviously responsiveness and complexity are related, since a highly responsive toy is also likely to be complex; in fact the correlation between the two scores was .70. Given the nonindependence of the two measures, it is not surprising that they predict very much the same behaviors in the child, namely exploratory behavior, goal-directed behaviors (including reaching and grasping), and secondary circular reactions. But, unlike responsiveness, which was slightly but significantly correlated with the child's motor development and with the total mental development index, the measure of complexity did not predict motor or mental development in general.

Of the three measures, variety, responsiveness and complexity, variety is the most highly predictive of overall mental development and is the only one which is significantly predictive of the child's "cognitive functions," of problem solving and object permanence, while both responsiveness and complexity are good measures of the domain called "goal-directed behaviors."

Some More Global Environmental Assessments

Mention must be made of several other studies which have attempted more molecular analyses of the environment than a simple assessment of quantity of stimulation but which have used assessment procedures which cannot be classified as measures of variety, responsiveness, or complexity. One of these (Caldwell, 1971) uses the Caldwell Home Inventory for Infants. In its several versions, the Caldwell Home Inventory includes items which touch on the variety and complexity of the environment, although individual scores for these dimensions are not derived. More typically, the Inventory yields a total score, which includes information about animate as well as inanimate stimulation. In Caldwell's own study the Home Inventory for Infants was used to assess the

homes of a group of approximately 30 children who had been enrolled in a day center from early infancy. She reports:

"A recent comparison of stimulation scores and of changes on the Cattell Infant Intelligence Scale between 6 and 12 months showed that positive IQ changes had occurred in children from homes earning high scores and that negative changes were the general pattern in children from low-score homes" (Caldwell, 1971, p. 165). Of course this finding does not tell us whether the animate or the inanimate stimulation was the more crucial, nor which dimensions of general cognitive and motivational development were affected.

A somewhat different assessment of environmental quality, although based on the same sorts of premises, has been used by Whiteman and Deutsch (1968), who have worked primarily with older school-age children and families. After considerable research on a variety of possible measures of environmental quality, they settled on a "deprivation index" which is made up of six items: (1) the degree of housing dilapidation, (2) the education aspiration level of the parent for the child, (3) the number of children under 18 years of age in the home, (4) the amount of dinner conversation, (5) the total number of cultural experiences during a week (including visits to relatives, family, library, zoo, school work, etc.), and (6) the kindergarten attendance of the child.

When children whose home environments have been evaluated on this deprivation index are given tests of overall cognitive functioning or of vocabulary, Whiteman and Deutsch find: (1) That children from families with more deprivation (as measured by their index) do more poorly on measures of vocabulary and general intelligence; (2) This holds even when race and social class are kept constant. For example, among a group of poverty-level white (or black) children, those from the most deprived homes have the lowest scores. (3) Those children from the most deprived homes are likely to show decreasing IQ with age while those from similar social class levels, but with less deprivation in the home, do not show this cumulative deficit. (4) Finally, those children from the more deprived homes are much more likely to have very poor self-concepts.

Clearly this study does not separate animate and inanimate stimulation, nor does it give us a very good differentiation of either domain. But it does highlight the fact that the degree of "deprivation" is the crucial factor, and not the occupation or education of the parent per se. Social class and education are correlated with measures of "deprivation" or with measures of variety of stimulation, so that using a range of social class or

educational groupings as a way of selecting subjects will provide variability on the environmental dimensions to be examined. It is the specific environmental dimensions, however, that are of importance. Yarrow's work offers some highly provocative leads about appropriate or useful ways to go about assessing the environment; hopefully, other researchers will follow this lead.

Some Final Comments

Two issues deserve further comment. First, how does one deal with the apparent paradox of the findings that in some cases a lot of stimulation has a negative effect, in other cases a positive effect? The simplest way to conceptualize this, as suggested earlier, is to view environmental stimulation along a continuum, from none to massive amounts. No doubt the "appropriate" or "optimum" level of stimulation lies somewhere in the middle. But Yarrow's work demonstrates that the optimum level of stimulation may be quite different for different dimensions of the environment or for different modalities of stimulation. Comparatively low intensities of auditory stimulation may be optimum, but a high degree of variety of auditory stimulation may also be optimum. White's research suggest that with visual stimulation, too, there may be such a thing as too much variety, at least for a particular age of infant. For an older infant, the same degree of variety may be quite appropriate.

In order to specify optimum environmental stimulation, it is necessary to specify optimum levels for each modality, for each dimension, for each age of child, and for each state of the child—since a sick or upset child may have a very different level of tolerance than an alert, well child. It should also be remembered that on most dimensions, and for most modalities, the optimum level seems to be quite a lot of stimulation.

Second, a word is needed about measurement. Yarrow has provided the most detailed analysis of environmental stimulation, but he did so at a cost of 6 hours of detailed observation time in each home. Caldwell's Home Inventory for Infants, on the other hand, can be scored after a briefer visit to the home and requires substantially less training to administer. But it does not yield the same detail. Fortunately, one need not choose between the two. It is possible to devise an assessment device, modeled after the Caldwell, which will yield separate scores for the various dimensions identified by Yarrow. Thus, one can rate a home, after a comparatively brief visit, on variety, complexity, and responsiveness of inanimate stimulation, and one can score the mother's behavior on the various dimensions, such as the amount of positive

affect, reaction to the child's distress, overall mood and quality of social stimulation, etc. Whether such a global assessment would be as fruitful as the detailed counts taken by Tannock and his associates remains for further research to answer.

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Chapter 7

Physical Growth and Development

The subject matter of this section is one of the most well-studied health outcomes. In spite of the tremendous wealth of information available, there remain unanswered questions, and, in everyday practice, the monitoring of physical growth is underplayed. Even though physical growth is intrinsically complex, influenced by environmental as well as genetic factors, it is an extremely valuable index of a person's health and well-being.

It is the intent of this section to collate selected facts from the literature which demonstrate complexity and phenomena of growth, accepted methods of measurement, and common growth disturbances.

Definition and General Principles of Growth and Development

Most authorities agree that growth is the increase in size of cells, tissue, and body parts, while the process of development implies an increase in complexity, differentiation of tissue and function. Although children vary greatly in the rate at which they develop, in their tempo of growth, the organization of growth is a very regular process and each person has his own individual pattern of growth. When this pattern is disrupted by environmental influences such as illness, malnutrition, or stress, growth may stop temporarily but will quickly proceed to "catch up" to the prior pattern as soon as normal conditions are resumed. Tanner (1970, p. 126) uses Waddington's term *canalization* to describe this tendency of growing organisms to return to their original paths of growth after deviation and refers to the rapid growth which returns the individual's growth pattern to the original curve as *catch-up growth*.

Commenting further on this phenomenon he says "The mechanism of canalization is at present very little understood. Females are better canalized than males, in respect of most characters, in man and all other mammals that have been investigated. Thus girls slow their growth less in response to malnutrition or disease than boys. . . . The earlier and the more prolonged the stress, the more difficult it is for regulation to be fully effective in restoring

the prestress situation. . . . The evidence leads us to believe that it is both the duration of the malnutrition and the magnitude of the normal rate of growth at the time the malnutrition is applied that determine whether a full catch-up is possible" (Tanner, 1970, p. 127).

Another general principle of growth is the ability of the body to harmonize and coordinate the velocity of growth of one part of the body to another. "Variations in the speed of development of different structures and functions (heterochronisms) underlie many individual differences in bodily structure. Examples are the longer arms and legs relative to trunk in men as opposed to women or in Negroes as opposed to whites" (Tanner, 1970, p. 130; 1973, p. 4). When the speeds at which different structures and functions develop do not harmonize, dysharmonic development results: "The behavior of children with precocious puberty provides an instructive example of an extreme, pathological degree of heterochrony, in which a fully developed endocrine system acts upon a less developed brain" (Tanner, 1970, p. 131).

A third aspect of growth which Tanner (1970, p. 131) describes is "the much-discussed critical periods which are extreme examples of differential growth events. . . . By 'critical period' we mean a certain stage of limited duration during which a particular influence from another area of the developing organism, or from the environment, evokes a particular response. The response may be beneficial, indeed perhaps essential to normal development, or it may be pathological. The term 'sensitive period' is now displacing the term critical period. This describes the usual situation more accurately, since usually these periods consist of a number of hours, days, or weeks during the beginning and end parts of which the organism is slightly sensitive to the specific influence, with a period of maximum sensitivity in the middle."

Normal Patterns of Growth and Development

The measurements of physical growth are of utmost importance in screening or assessing the quality and level of development and integration taking place in an individual child. During the first 5 years of life, when growth is especially rapid, deviations in the normal parameters of physical growth can be extremely useful as clinical indices of a disorder. As Watson and Lowery (1967, p. 74) point out, "such [physical] measurements are made to reinforce and improve clinical judgment and not to displace it." Three body measurements commonly used to follow growth over a period of time are reviewed in this chapter: height, weight, and head circumference.

Height

Height reflects the interaction between genetic differences and environmental influences; and therefore, in assessing height, it is important to consider whether or not the child is expressing a genetic endowment or an abnormal rate of development. Since height is not affected by environmental factors to the extent that weight is, it is presently considered to be the most useful growth variable. The maximum rate of growth in height occurs before birth, in the fourth month of fetal life. In contrast to weight, the annual increments in height continually diminish from birth to maturity except for a short period referred to as the adolescent spurt of growth.

The average newborn infant has a birth length of 20 inches (50 centimeters) and increases in length by about 50 percent during the first year of life, growing 10-12 inches (25 to 30 centimeters) (Nelson, Vaughn, McKay, 1969, p. 21, 23). Several unusual forms of growth in length may occur during the first year of life and still fall within the normal phenomena of growth even though they may not follow the normal growth curve. These include: prematures who start well below the normal curve but catch up before their first birthdays; infants of diabetic mothers who may be longer than average but then make slow gains until they find their way onto the normal curve; infants who are short at birth due to impeded intrauterine growth but have accelerated growth during the first year once they have access to sufficient food; and children who have extremely tall or extremely short parents and express a genetic endowment in the height achieved during their first year.

During the second year of life, there is a further deceleration in the rate of growth. The average infant will grow approximately 5 inches (12 centimeters) during his second year, and after that his gains in height will remain relatively steady at about 2½ to 3 inches (6 to 8 centimeters) a year until the onset of the preadolescent growth spurt (Nelson et al., 1969, p. 26–28).

Both for psychological, social, and occasionally practical reasons, it is at times important to be able to predict the eventual adult height anticipated for a child. Sinclair comments that the predictive value of birth length is nil, because it is considerably influenced by the environment of the fetus in the womb, and he gives an example of a baby destined by genetic make-up to be tall who may measure relatively little at birth if it is premature, one of a multiple birth, or born to a young mother. "But, by the second birthday, the child has joined the genetic curve which basically

determines his height, and predictions become more reasonable. From the age of 3 years to the age of the adolescent spurt, the predictive reliability is quite high, with a peak at the age of 8 years for girls and 10 years for boys" (Sinclair, 1969, p. 25).

Tanner et al. found in the Aberdeen growth study that the height at 3 years showed a fairly good correlation with height at maturity, and as a result came up with the following formula:

H_m (cm.) = 1.27 x H_3 + 54.9 cm. (males)
H_m (cm.) = 1.29 x H_3 + 42.3 cm. (females)
H_m = height at maturity (cm.)
H_3 = height at 3 years of age (cm.)

with standard errors of estimate of 3.9 and 3.6 cm. (1956, p. 379).

Weight

Although weight is only one indicator of developmental maturity, it continues to be an important variable in most studies of infants because of the comparative ease in collection of data, and because it is subject to less error than other measures of maturity and growth.

The weight at birth is more variable than the length and reflects the maternal environment more than the heredity of the baby. Among the maternal variables associated with low birth weight are: biological immaturity, i.e., under 17 years of age; high parity; short stature; low pregnancy weight for height; low gain in weight during pregnancy; poor nutritional status; smoking; certain infections; chronic disease; complications of pregnancy; history of unsuccessful pregnancies; multiple births; and low socioeconomic status (Birch, 1970).

"The maximum growth rate in weight, unlike the maximum rate of growth in height, is not achieved until shortly after birth" (Sinclair, 1969, p. 26). The average newborn infant weighs approximately 3.4 kilograms (7½ pounds), boys being slightly heavier than girls. Approximately 95 percent of full-term newborn infants weigh between 2.5 kilograms (5½ pounds) and 4.6 kilograms (10 pounds). During the first few days of the neonatal period, some loss of weight is normal, usually less than 10 percent of the birth weight, and birth weight is generally regained by the tenth day. During the first 5 months, a healthy infant should gain approximately 20 grams per day and approximately 15 grams per day for the remainder of the first year. At 4-5 months the average infant has doubled his birth weight, at 1 year it is tripled, and by the end of the second year the birth weight is quadrupled. During the second year of life, the monthly increment in weight is reduced to slightly more than .2 kilograms, to produce a gain

for the second year of 2.5 kilograms (5 to 6 pounds). During the period from 2 to 6 years there is a slow, steady weight gain of about 2.0 kilograms (4.5 pounds) per year (Nelson, et al., 1969, pp. 21, 23, 27).

Head Circumference

The occipito-frontal circumference measurement is a well-established clinical index of head growth. This is considered to be an extremely important measurement, because growth of the head is both a gauge of the cellular growth patterns of the brain and a reflection of the fluid contents of the cranium. It is a much more accurate index of brain growth than is the presence or size of the fontanel.

In the normal newborn infant the bones of the cranium are separated, but shortly after birth the definitive sutures are established. If these sutures are obliterated, growth stops and deformities of the skull occur, the more common ones being described by the terms scaphocephaly, brachycephaly, oxycephaly, tower skull, etc., For such abnormalities the measurement of head circumference will not give the true volume of the cranial vault.

The anterior fontanel is generally about 2–3 centimeters or 0.8 to 1.2 inches in width and 3 to 4 centimeters or 1.2 to 1.6 inches in length. It may increase in size for several months after birth, but generally diminishes in size after 6 months and may become effectively closed at any time from 9 to 18 months. The posterior fontanel is generally closed to palpation between 2 to 4 months (Nelson, 1969).

The average newborn has a head circumference of 34 to 35 centimeters which increases to approximately 44 centimeters by 6 months and to 47 centimeters by 1 year; or in other words, it increases approximately 12 centimeters (4 in.) in the first year of life. During the second year of life the head circumference will increase only 2 centimeters, reflecting a marked deceleration of growth. By the end of the first year the brain has reached approximately two-thirds of adult size, and at the end of the second year, four-fifths of its adult size (Nelson et al., 1969, p. 25). (See head circumference graphs in Chapter 2, Congenital Abnormalities).

Factors Influencing Growth

Both heredity and environmental factors influence growth and development, and the progress of any child is the result of a complex interaction between many different factors. Included among these factors are:

Genetic control: "Studies of twins have shown that body shape and size, deposition of fat, and patterns of growth are more nearly related to nature than to nurture. . . . Certain peoples are taller than others . . . [and] it is probable that genetic factors are largely responsible for such racial differences, though nutrition may also play an important part" (Sinclair, 1969, p. 108). Two recent studies indicate that there is no statistically significant difference between black and Caucasian infants in growth patterns for weight and height, but that there are differences in body proportions. Further, they suggest that, when differences do occur, they are probably the result of differing socioeconomic conditions rather than differing racial characteristics.

In the first study, Verghese et al. obtained physical measurements from 2,632 healthy North American black children of low-income families whose ages ranged from 3 months to 17 years. The principal dimensions measured were: (1) height, (2) weight, (3) stem length, (4) head circumference, (5) chest circumference, (6) biacromial diameter, (7) biiliac diameter, (8) length of upper arm, and (9) length of forearm and hand. Their chief finding was that the height and weight of black children were similar to those of the Caucasian children in Stuart's Boston study and Jackson and Kelly's Iowa study. On the other hand, head circumference and stem length were consistently smaller than those reported for Caucasian children by Nellhaus and Meredith respectively. Since the stem length was comparatively shorter in the blacks, while the height was approximately the same in both racial groups, it was assumed that the lower extremities of the blacks are longer than those of Caucasian children of the same age. In addition, the authors found that at 1 year of age, the weight, head circumference, and chest circumference of the black infants from low-income families in this study were significantly smaller than the same measurements previously reported for infants of the same race from middle-income families in the same city (Verghese et al., 1969, p. 246–247).

In the second study, measurements of height, weight, and head circumference in the first 2 years of life were obtained on more than 15,000 California children. These children were from a middle-class, multiracial population (66 percent white, 23 percent black) who were enrolled in a prepaid medical care program. The results showed that under comparable economic circumstances there were few differences in growth between these two races, and the investigators concluded that if children live under comparable socioeconomic conditions, separate growth curves for the

two races were not necessary (Wingerd, Schoen, Solomon, 1971, p. 825).

Sinclair (1969, p. 109) comments that "genetic factors probably play the leading part in the difference between male and female patterns of growth," which result in the need for separate standards of normality. There have been numerous investigations which show a sex difference in the timing of growth (Karlberg et al., 1968; Tanner, 1970), and it is generally agreed that girls, beginning in fetal life, mature physically faster than boys. "The basic difference between boys and girls up to age 3 . . . seems to be a predominance of skeletal tissue in boys and of subcutaneous tissue in girls" (Karlberg et al., 1968, p. 55).

Neural Control: Sinclair (1969, p. 110) has reviewed the evidence for a "growth center" which controls physical growth and suggests that it may be located in the hypothalamus of the brain. Atrophy of tissues after denervation would seem to indicate that the peripheral nervous system may also play some part in the control of growth.

Hormonal Control: Watson and Lowery (1967, p. 52) summarize the importance of hormonal control in early physical growth and development by pointing out that secretions of the endocrine glands act as catalysts to the normal growth potentials of the body. Some are growth-promoting, such as the pituitary growth-stimulating hormone and androgens. Others, such as thyroid hormone, androgens, and estrogens, cause maturation. And some hormones may be antagonistic to growth but are useful in other ways when in proper balance, the adrenal cortical corticoids for example.

Nutrition: Both prenatal and postnatal nutritional status of a child affect his growth and development. This subject is reviewed in detail in the chapter on nutrition.

Socioeconomic Class: Children from different socioeconomic levels differ in body size at all ages. The British children in the high socioeconomic class of the professional and managerial classes are taller than the children of unskilled laborers by about 2.5 centimeters (1 inch) at 3 years of age and by about 4.5 centimeters (1½ to 2 inches) at adolescence. The number of children in the family is also important; children from large families have been shown to be usually smaller and lighter than children from smaller families (Tanner, 1970, p. 143).

Season and Climate: Growth in height is faster in the spring than in the autumn by a factor of from 2 to 2½ times. Growth in weight, on the other hand, proceeds faster (sometimes four or five times faster) in the autumn than in the spring. Thus

children tend to grow in height in the early part of the year and to fill out in the latter part, although individuals may show a rhythm different from that of the majority, probably reflecting individual variation in endocrine and hypothalamic reactivity (Tanner, 1970, p. 139).

At this time, it is not known what direct effect (if any) climate has on growth patterns. This factor is difficult to separate from the other variables in a culture affecting growth (Tanner, 1970, p. 138–139).

Disease: Tanner (1970, p. 140) speaks to the influence of illness on physical growth as varying with its severity. Minor and relatively short illness may cause some disturbance in children with a less-than-adequate diet but does not retard the growth rate in the great majority of well-nourished children. Major diseases may cause a considerable slowing down of growth, followed by a catch-up when the disease is cured. And chronic disease may affect physical growth, but it is difficult to separate any slowing of growth which it may cause from that due to malnutrition which often accompanies it.

Emotional Stress: Severe psychological stress may affect growth, but there is no evidence that the ordinary ups and downs of life have any effect on a child's growth (Tanner, 1970, p. 143). Noting that deprivation dwarfism and sleep abnormalities often go together, Gardner recently suggested that stress due to maternal deprivation might cause disturbed sleep patterns resulting in inadequate levels of somatotrophin to support normal growth (Gardner, 1972, p. 81).

Prenatal Environment: In considering the effects of the intrauterine environment on infant growth, Watson and Lowery (1969, p. 42) emphasize the importance of the embryonic period because the sensitivity of the various organs to noxious agents is greater at the time of rapid differentiation than it is later. Chapter 1, Prenatal and Perinatal Factors, discusses specific noxious agents in more detail.

Secular Trends: Tanner (1970, p. 144; 1973, p. 42) comments that during the last hundred years there has been a striking tendency for children to become progressively larger at all ages. To indicate the amount of change, Sinclair (1969, p. 117) gives a rough rule for preschool children: the average secular gain in size has been about 1.3 centimeters (½ inches) in height and 0.5 kilograms (1 pound) in weight for each decade since about 1900.

Monitoring Physical Growth

It is not possible in this monograph to review all of the methods available for assessing normal growth and development in children, but to obtain more comprehensive information, the reader is referred to Watson and Lowery (1967), who provide a comprehensive review of the various methods of assessing children's growth and development. In a more recent publication, Owen (1973) reported on a conference on the Assessment and Recording of Measurements of Growth of Children held at the American Academy of Pediatrics in November 1971. The assembled group of experts examined the measures of physical growth in use in the United States and concluded with a number of recommendations. Height, weight, and head circumference were the dimensions recommended for measurement. Skinfold thickness was not included because of the cost and technical difficulties involved in its use and because of the absence of reference standards for this variable. The suggestion for frequency of measurement of these three recommended factors (i.e., height, weight, and head circumference) was that they be measured at birth, before newborn hospital discharge, and at 1, 2, 4, 6, 12, 18, 24, 30, and 36 months of age; thereafter height and weight should be measured at yearly intervals. Owen (1973, p. 462) gives details of the specific techniques recommended for each dimension as follows:

Height: Recumbent length should be measured up to the third year of life, although in actual practice, it may be impossible to do so beyond 18 or 24 months. Satisfactory measurements of length require adequate equipment and availability of two examiners. One person holds the infant's head with the Frankfort plane vertical and applies gentle traction to bring the top of his head into contact with the fixed headboard. A second person holds the infant's feet, toes pointing directly upward, and also applying gentle traction, brings the movable footboard to rest firmly against the infant's heels.

Children 3 years of age and older may be measured in the standing position. It is strongly recommended that platform scales with movable measuring rods not be used for measuring height of children. A measuring stick or tape should be fixed to a true vertical flat surface such as the wall. The child should stand on a horizontal bare floor or platform with his bare heels together, back as straight as possible with the heels, buttocks and shoulders touching the wall or vertical surface of the measuring device; the Frankfort plane should be horizontal. A block, squared at right angles against the wall, is then brought to the crown

of the head and the measurement noted. This measurement can be handled by one examiner.

Weight: Body weight should be measured using appropriate sized beam or balance scales. Scales with nondetachable weights are recommended. Calibrated or standard weights should be available to check the accuracy of scales at least two or three times yearly. Measurements of weight are preferably made with subjects unclothed or, in the case of older children, clothed only in underpants or a light cotton gown.

Head Circumference: Head circumference should be measured by a flexible, narrow steel tape instead of a cloth or plastic one, because it will not stretch and it conforms more readily to the contours of a child's head than do disposable paper tapes. The tape is applied firmly around the head above the supraorbital ridges, or the most prominent part of the frontal bulge, anteriorly, and over that part of the occiput which gives maximum frontal-occipital circumference.

Owen (1973, pp. 463–464) comments at some length on the use of the measures once they have been taken: "Measures of physical growth are interpreted in relation to some expected value considered normal or usual for a child of the age, sex and genetic potential of the one being measured. . . . The presumption is that the atypical child is more likely than the typical child to have a disease. . . . The most fruitful interpretations of children's growth are made from serial observations rather than measures at a single point in time. Two measurements permit calculation of *growth* during a defined period of time while one-time measurements give only *size*. Also, the larger the time span during which accurate, serial observations are made, the surer will be the judgment as to whether a given child's measures are normal or abnormal. . . . There are no data to define sharply the extent of deviation from established patterns which identifies abnormality." To improve this situation the conference on the Assessment and Recording of Measurements of Growth of Children recommended that "new standards based on current measurements of more representative [than the population used by Stuart and Meredith] population samples should be substituted and their use promoted" and that "studies should be undertaken to ascertain the effectiveness of routine physical measures for detecting disorders of growth as indicators of significant disease. . . . Until then it is recommended that the height and weight standards of Stuart and Meredith continue to be used and the head circumference standards developed by Nellhaus (1968) be used" (Owen, 1973, p. 461).

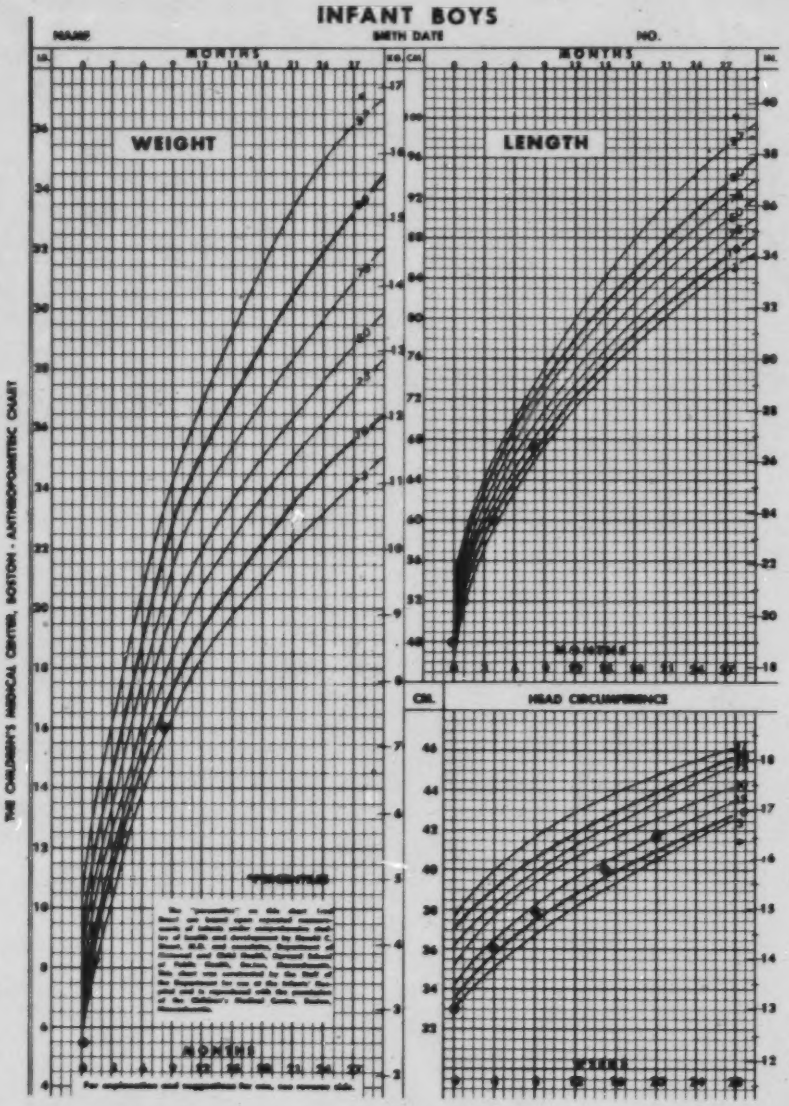
To demonstrate the use of an anthropometric chart, figure 11 presents data from birth to 8 months of age plotted on the percentile curves for boys developed by Dr. Harold C. Stuart and his associates at the Harvard School of Public Health. These standards are based on measurements of white children of North European ancestry living in Boston from about 1930 to 1946 who, although coming from the lower economic brackets, had the advantages of regular health supervision. The chart instructions state that "Under normal circumstances, one expects an infant to maintain a similar position from age to age—that is, on or near one percentile line or between the same two lines. Occasional sharp deviations or gradual but continuing shifts from one percentile position to another call for further investigation as to their causes." Although the infant described in figure 11 had a low birth weight, i.e., under the third percentile, his weight at 1, 4, and 8 months suggest that he is maintaining his trajectory. However, compared to the height and head circumference measures, both of which went from the third percentile at birth to near the twenty-fifth percentile at 4 months, this is a low weight gain and reason for obtaining a diet history to determine whether he was getting sufficient calories for his age and weight. The steady increase in height would seem to indicate that protein intake was sufficient but checking his parents' height would clarify the genetic contribution to his stature.

The growth curves used in this example and others in which the actual measurement at a given time is plotted against the child's age at the time the measurement was taken, is sometimes called a "distance curve," since any point on it indicates the distance the body has travelled along the road to maturity. It is clear that the curve must flatten out to a plateau as growth ceases. Another way of presenting the same data is by plotting the increments of growth (that is, the amounts added in specific time intervals) against time. Such a curve shows the variation in the rate of growth with time, and is therefore known as a "velocity curve." Ultimately, such a curve must tend to zero as growth ceases (Sinclair, 1969, pp. 11–12). On this subject, Falkner (1973, p. 747) comments that the study of human growth should be by methods employing the collection of distance and velocity data as appropriate, and often a study should include both.

Common Growth Problems

Despite the difficulties in identifying mild growth disorders, physical measurements are clearly abnormal in two problem situ-

Figure 11.—Anthropometric chart



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ations: low birth weight and failure to thrive. They both have significant impact on the total health of the child and can probably be prevented with appropriate health care strategies.

Weight at birth and gestational age have traditionally been used as the chief indicators of the adequacy of intrauterine growth, and "premature" was the word used to describe infants who were below the norm in either or both dimensions. An important attempt to distinguish between these two was the WHO recommendation that "low birth weight" be applied to infants who weighed 2,500 grams or less at birth and that "premature" be reserved for infants whose gestational age was less than 37 weeks.

It is now recognized that measurement which reflects both birth weight and gestational age is more helpful in predicting infant outcome than either measure by itself. The fact that an accurate birth weight is fairly easy to obtain certainly contributes to its having been depended upon more widely than the often indefinite report of the mother's last menstrual period from which gestational age is usually estimated. Fortunately, several investigators have determined fairly accurate means of assessing gestational age, taking into account clinical appraisal of the newborn's neurological and physical characteristics in addition to the mother's menstrual history.

Farr et al. (1966) defined 11 physical characteristics of newborn babies that they felt were of practical value in assessing gestational age: (1) skin texture, (2) skin color, (3) skin opacity, (4) lanugo, (5) edema, (6) ear firmness, (7) ear form, (8) genitalia (descended testis, labia majora covering labia minora), (9) breast size, (10) nipple formation, and (11) plantar skin creases.

The studies of French investigators (Amiel-Tison, 1968; Saint-Anne Dargassies, 1955) pursued the neurological development of the fetus. They felt that the gestational age could be estimated by particular neurological reflexes and tone. For example, the tone was evaluated in terms of neck extensors and flexors, the scarf maneuver, and the degree of resistance in putting the heel to ear. The reflexes they found pertinent included the Moro, grasp, rooting, pupils to light, crossed extension, automatic walk, trunk elevation, glabellar tap, and the ability to turn the head to light.

Dubowitz, Dubowitz, and Goldberg (1970) devised a method for clinical assessment of gestational age by developing a scoring system which included 10 neurological criteria and the 11 "external" criteria as described above by Farr. The 10 neurological

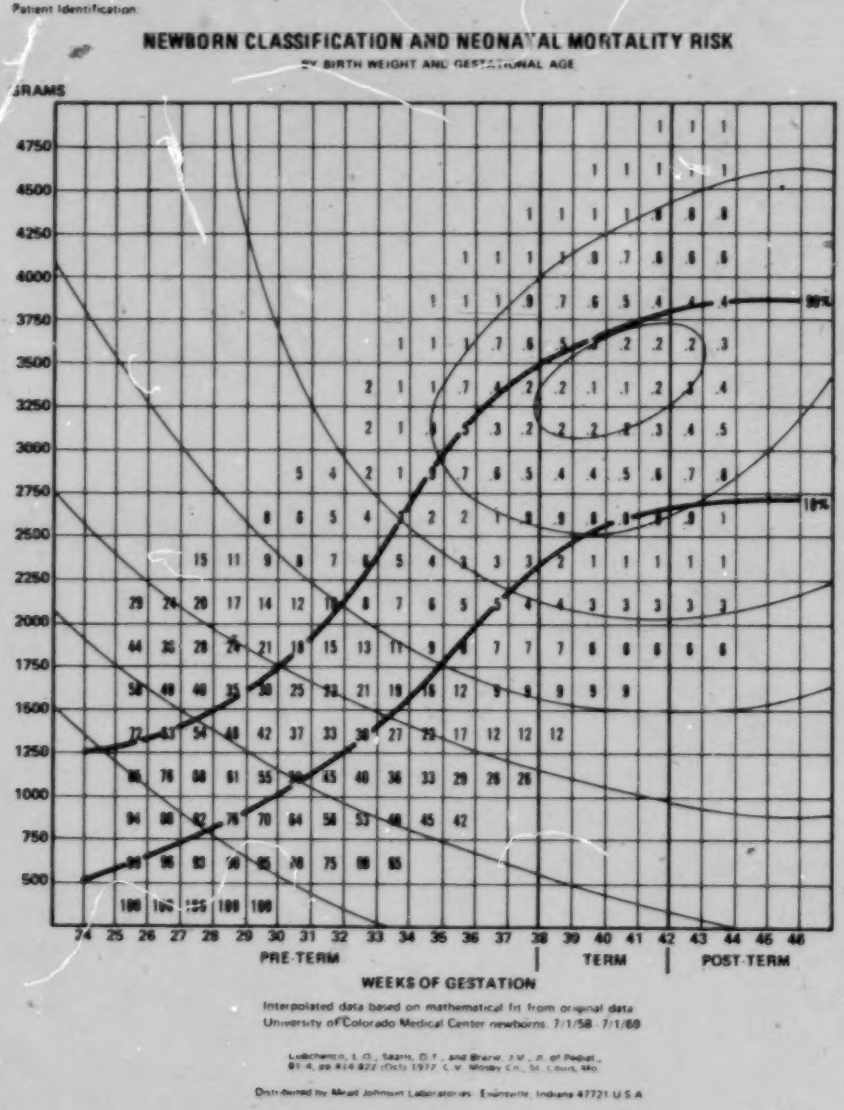
criteria used were: posture, square window, dorsiflexion of foot, arm recoil, leg recoil, popliteal angle, heel to ear, scarf sign, head lag, and ventral suspension. They found that by combining the "external" and neurological scores under one scoring system, the system gave a better correlation with gestational age than did any one individual score: the correlation coefficient for the total score against gestation was 0.93. Also, the system was reliable in the first 24 hours and gave consistent results within the first 5 days.

Once the gestational age and birth weight of the infant are determined, the infant's weight can be classified as appropriate, small, or large for gestational age. As shown in figure 12, Battaglia and Lubchenco (1967, p. 162) describe all infants above the ninetieth percentile as "large for their gestational age," those below the tenth percentile as "small for their gestational age," and those between the tenth and ninetieth percentile as "appropriate for their gestational age."

The numbers given in the blocks in figure 12 are the percent mortality for the indicated birth weight and gestational age, and the shaded curvilinear zones connect the blocks having similar mortality rates. Lubchenco, Searls, and Brazie (1972) developed this Newborn Classification and Neonatal Mortality Risk for the purpose of evaluating individual pregnancies on the basis of both birth weight and gestational age. Although it does not include many maternal factors which are known to contribute to neonatal death, the authors offer it as a first step in screening large newborn populations in order to identify infants who are at risk. An important practical use for the graph is in assigning the level of care given to an individual infant: based on birth weight and gestational age, each newborn can be assigned a neonatal mortality risk. In the Newborn Service at the University of Colorado Medical Center, any infant whose mortality risk is greater than 10 percent is expected to need continuing special care, regardless of other factors. An example of such a case would be a newborn of 1,500 to 1,750 grams birth weight born at 33 to 34 weeks gestation whose block on the graph shows a mortality risk of 19 percent. Also, the obstetrician considering preterm delivery because of underlying maternal or fetal disease can use this type of assessment to weigh the risk due to the disease condition against the mortality risk to the fetus of shortened gestation.

In addition to increased mortality rates, low-birth weight infants show other sequelae of that condition: several studies (Lubchenco, Horner, Reed, Mix, Metcalf, Cohig, Elliott, Bourg, 1963; Drillien, 1970, 1972; Beargie, James, Greene, 1970; Fitz-

Figure 12.—Chart of newborn classification and neonatal mortality risk



From Lubchenco, L. O., Searls, D. T., and Brazie, J. V.: Neonatal mortality rate: Relationship to birth weight and gestational age, *J. Pediatr. 81*:814-822, 1972. Reproduced with permission from the authors, the C. V. Mosby Company, St. Louis, Missouri, and Mead Johnson Laboratories, Evansville, Indiana.

hardinge and Steven, 1972; Cruise, 1973) have been completed which give information about the implication of being underweight for gestational age. For example, Fitzhardinge and Steven followed 96 children with severe intrauterine growth retardation and found in a 5-year followup that while major neurological defects were uncommon, there was a high incidence (25 percent) of minimal cerebral dysfunction characterized by hyperactivity, a short attention span, learning difficulties, poor fine coordination, and hyper-reflexia (Fitzhardinge and Steven, 1972, p. 50). Since there was no significant correlation with intelligence scores, but a high incidence of the aforementioned symptoms and poor school performance, a specific learning disorder, rather than general mental retardation, is suggested.

Especially pertinent to this chapter is Cruise's study of low-birth-weight infants who were compared to infants who weighed more than 2,500 grams at birth. The purpose of that study was to supply tables which may serve as standards for velocity and distance growth from birth through 3 years of age of preterm and of full-term, low birth weight, Caucasian, single birth, healthy infants (Cruise, 1973, p. 626). The low-birth-weight neonates were divided into three groups by gestational age as follows:

Preterm infants with normal measurements for gestational age:
- Group I: 28–32 weeks of gestation
- Group II: 33–36 weeks of gestation

Term infants but small for date (SFD):
- Group III: 37–42 weeks of gestation

Regular and accurate measurements of weight, length, and head circumference were done on all three groups and on a group of full-term comparative infants who weighed more than 2,500 grams at birth. The findings showed that low-birth-weight infants made greater velocity growth during the first year of life than comparative infants, particularly in head circumference and length but they did not attain the distance growth of comparative infants. . . . The most rapid growth for all low-birth-weight infants occurred during the first week of life. The SFD infants grew less rapidly than the preterm groups of low birth weight (Cruise, 1973, pp. 625–626).

Falkner (1973, pp. 746–747) points out that the Cruise data confirm the fact that by 3 months of age the head circumference of preterm infants is very similar to that of full-term infants despite the fact that at birth it is very much smaller. And he emphasizes that the markedly greater first 3-month growth velocity in head circumference of preterm babies achieves catch-up and

should not be confused clinically with possible developing hydrocephalus.

With so much evidence that poor intrauterine growth indicates "at risk" status for later health, the search for significant variables correlated with low birth weight at a significant statistical level has intensified. Rosenwaike's finding (1971) that infant birth weight varied inversely with level of maternal education is of interest in this connection. Specifically, the incidence of low-birth-weight infants born to mothers with 10 or fewer years of education was 10.7 percent whereas the incidence dropped to 4.4 percent among mothers who were college graduates. When additional analyses of other variables such as race, birth order, and prenatal care were taken into account, the better educated women still had a lower incidence of low-birth-weight infants. Rosenwaike concluded, "Educational level thus appears to play a more salient role in determining birth weight than any of the other factors studied" (Rosenwaike, 1971, p. 649).

Failure to Thrive

Technically, the diagnosis of "failure to thrive is defined as a rate of gain in length and or weight less than the value corresponding to two standard deviations below the mean during an interval of at least 56 days for infants less than 3 months of age and during an interval of at least 3 months for older infants. Infants gaining in length or weight below the 10th percentile expected for his age should be regarded as suspect" (Fomon, 1967, p. 11). The behaviors and/or conditions generally associated with the problem of failure to thrive in the young child are: (1) inadequate food intake; (2) recurrent vomiting; (3) abnormally great fecal losses—food malabsorption; (4) high energy requirements; and (5) stress which causes increased cortisone output (Fomon, 1967, p. 23).

The frequency with which children are hospitalized with the diagnosis of "failure to thrive" seems to be increasing; the etiology and treatment are subjects of interest to clinicians and researchers alike. Does the lack of growth represent a lack of food intake, metabolic disorder, or disturbance in the mother-child relationship?

Whitten's study (1972) was specifically designed to determine whether the stunting of growth in deprived children was due directly to caloric insufficiency or to some effect of psychosocial deprivation on the child's growth control mechanisms. Growth patterns were followed in failure-to-thrive children who were fed an ample diet under home conditions which were kept un-

changed insofar as any apparently pathogenic psychosocial characteristics were concerned. An observer took to the home a diet consisting of the same food in the same quantities which the mother had claimed (falsely, as it turned out later) she had been feeding the infant. This was done three times a day for 2 weeks, and the food was fed in the presence of the observer who delivered the food. The study findings showed that these children gained and grew at "catch up" rates similar to those observed in children who had been extricated from similar maternally deprived homes and placed in more adequate homes.

Whitten comments:

> Our studies indicate that maternally deprived infants did not eat enough food in the home because they refused, or because it was not offered Refusal of food is not common. The understimulated, withdrawn, apathetic infant may lose his appetite, but *more frequently it is ravenous.* The reasons why infants with a good appetite are not fed and mothered adequately when cared for at home by their own mothers are, of course, related to the mothers' psychological status. The mother develops behavioral patterns which include understimulation and underfeeding of a child as a result of either intrapsychic conflict, a destructive environmental or social setting, or some combination of these. . . . (1972, p. 13).

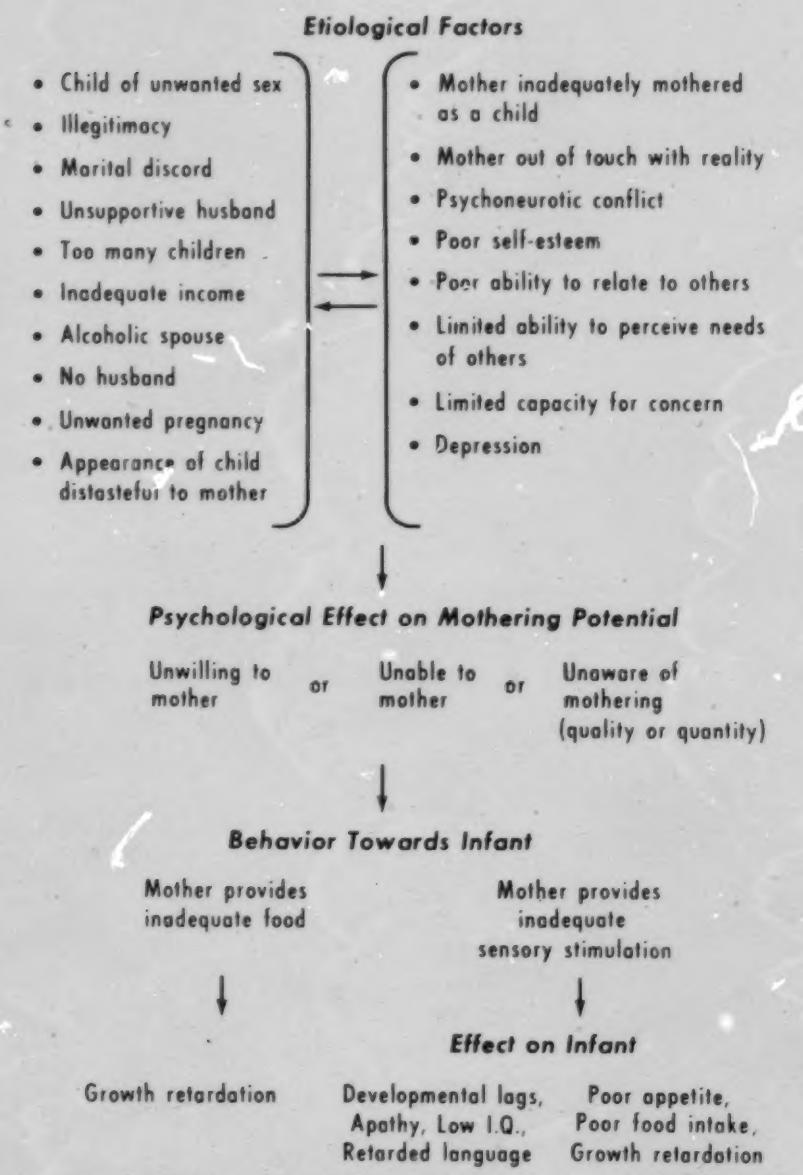
In the past it was thought that growth failure secondary to maternal deprivation was solely the result of lack of maternal care, stimulation, and love. Whitten offers an alternate way of representing the pathogenesis of growth failure. His theory is presented in figure 13.

The most common factor involved in growth failure is an inadequate dietary intake, but why wouldn't an infant receive an adequate intake? Referring back to the description provided by Whitten, one factor might be a poor mother-infant relationship where the mother is not able to offer food to the baby in a way that makes it possible for the infant to take it in. Other possible explanations might be an inadequate volume of human milk, poorly devised formula, presence of a congenital malformation of the gastrointestinal tract, or disease. Certainly careful study of each case is required to determine the cause. It is not unusual for such children to be hospitalized or taken care of in a foster home to both determine the adequacy of food intake and closely monitor weight gain. It is often true that these children demonstrate a remarkable velocity of weight increase while under observation.

Summary

Evidence cited suggests that for an initial screening of a child's physical health, the important measures are height, weight, and

Figure 13.—Whitten's theory of growth failure.


Pathogenesis of Growth Failure Secondary to Maternal Deprivation
Etiological Factors
• Child of unwanted sex
• Illegitimacy
• Marital discord
• Unsupportive husband
• Too many children
• Inadequate income
• Alcoholic spouse
• No husband
• Unwanted pregnancy
• Appearance of child distasteful to mother
• Mother inadequately mothered as a child
• Mother out of touch with reality
• Psychoneurotic conflict
• Poor self-esteem
• Poor ability to relate to others
• Limited ability to perceive needs of others
• Limited capacity for concern
• Depression
Psychological Effect on Mothering Potential
Unwilling to mother
or
Unable to mother
or
Unaware of mothering (quality or quantity)
Behavior Towards Infant
Mother provides inadequate food
Mother provides inadequate sensory stimulation
Effect on Infant
Growth retardation
Developmental lags, Apathy, Low I.Q., Retarded language
Poor appetite, Poor food intake, Growth retardation

From Whitten, C.: T.L.C. and the hungry child. *Nutrition Today* 7:1:10-15, 1972. Reproduced with permission from the publisher.

head circumference and, in the case of some newborns, gestational age. The measure obtained must then be compared to the "normal" measurements for a child of that age, sex, and background, using any one of the several sets of normative data available. Such a preliminary assessment would ordinarily permit the identification of those children with marked irregularities in physical growth and development, although the cause of the irregularities would require further examination of the child, his genetic potential, and his home environment.

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Chapter 8

Sleep Patterns

Sleep as an Index of Adaptation

An individual's sleep pattern is quite stable, being mutually influenced by the central nervous system and the environment. To demonstrate the powerful influence of environment on the central nervous system's regulation of sleep, it is noted that the infant within 12 to 16 weeks after birth usually accommodates his pattern of sleep to match that of the family. In other words, the infant is generally able to sleep through the night, which means maintaining an 8-hour sleep period (Parmalee, Wenner, and Schultz, 1964). Since sleep is a function of the central nervous system influenced by environment, it becomes a useful clinical index of the individua"s well-being. This fact has been gaining increasing professional attention, and at the same time has shifted to become a high priority maternal concern for infants in this decade. In a survey done on 3-year-old children, Ragins and Schachter (1971, p. 464) found that 46 percent of the mothers interviewed had been or were concerned about their child's sleep. "In our culture in recent years, concern and complaints about the sleep problems of small children have become more frequent than complaints about their eating problems. Some form of sleep disturbance is almost universal during the second year of life, and many sleep problems which continue in later years first appear at this time."

What then can cause a child to have an atypical sleep habit, and therefore, a sleep problem? Before delving into this question, we must first define sleep and clarify what is typical in terms of the sleep pattern of the developing child.

Definition of Sleep

> As long as we do not know how and why sleep forces on us a necessary and recurrent change in the process of our relationships with our environment, it is impossible to give a definition of sleep that would satisfy everyone. . . . On the one hand we must assume that our brain, like our kidneys and heart but unlike our musculature system, does not rest during sleep. On the contrary, it undergoes an active reorganization rather than a real inhibition, and so it seems to be an active phenomenon. On the other hand, it appears that behavioral

139

> sleep does not proceed from a single process but is the manifestation of two different states of nervous activity, although these are closely interconnected. The electrical activity of the brain of the sleeping mammal has a recurring evolution proceeding from two opposite modes. The first mode, which is the earliest known, manifests itself in the presence of the synchronized cortical activity of spindles and/or high-voltage slow waves. The other mode reveals itself by low-voltage fast cortical activity similar to arousal activity (Jouvet, 1967 pp. 117–118).

The preceding statement by Jouvet, a leading neurophysiologist in the field of sleep, represents somewhat of a dilemma as well as the current attempt to define what sleep is. In essence, most people now think of sleep as an active process rather than a passive process which was formerly described by Kleitman (1963). The pioneering work of electroencephalography in describing different patterns of bioelectric brain activity during sleep was followed by the findings in 1953 of Aserinsky and Kleitman of a peculiar EEG pattern, resembling that of wakefulness, which occurred periodically during sleep and coincided with rapid eye movements. Most recently discoveries in neurophysiology made especially by Jouvet (1969) led to the conclusion that sleep is not a quantitative continuum of decreasing and again increasing vigilance, but that it consists of two different states of behavior and neural organization: sleep with rapid eye movements and sleep without rapid eye movements. The alteration between rapid eye movement sleep and nonrapid eye movement sleep occurs in all mammalian species from man to oppossum.

The various states of sleep and arousal have in common the brain stem reticular activating system, although the main centers of control are at different levels in the brain stem. Nonrapid eye movement sleep and arousal definitely seem to be dependent on the higher centers of control in the brain stem, particularly cortical feedback mechanisms (Parmelee, 1970; Dittrichova and Lapachova, 1964; Jouvet, 1967). Nonrapid eye movement sleep is regulated from the medullary activating system with concomitant inhibition of the pontine and mesencephalic centers, whereas rapid eye movement sleep is induced by pontine centers which inhibit the mesencephalic ascending and descending activating systems that stimulate the cortex. Arousal is dependent on the mesencephalic reticular activating system which in itself can be further activated or inhibited by the cortex (Parmelee, 1970; Jouvet, 1967; Kleitman, 1969; Dreyfus-Brisac, 1970; Korner, 1968; Lenard, 1970).

A possible monoaminergic theory of sleep has come into discussion during the past few years. Serotonergic neurons of the

raphe complex and catecholaminergic neurons of the pontine tegmentum appear to be of crucial relevance in triggering of the two states of sleep. Increase in brain serotonin leads to an increase in nonrapid eye movement sleep and blockage of monoaminooxydase leads to an elective suppression of rapid eye movement sleep, while the amounts of rapid eye movement sleep can be increasd by reserpine releasing monoamines at the monoaminergic terminals (Lenard, 1970).

While there are suggestions as to the mechanisms responsible for sleep, there is not conclusive evidence as to the actual controlling mechanisms. There is, however, ample evidence that sleep consists of two highly specific and well organized different states, that of nonrapid eye movement and rapid eye movement sleep, characterized by certain physiological parameters such as respiration, heart rate, blood flow, motor activity, EEG, and certain behavioral manifestations. These two states alternate in a fixed pattern, the normal variability in the coordination of the various parameters and in the homeostasis of the two states (Schulte, 1970).

Kleitman (1969) has proposed the concept of the basic rest activity cycle (BRAC) continuous throughout 24 hours that is expressed as active and quiet states during sleep, and as waxing and waning of attention during wakefulness. The apparent interrelatedness of the neurophysiological controlling mechanisms for sleep states and those for wakefulness support this hypothesis. Kleitman describes the basic rest activity cycle as being a function of the central nervous system. The BRAC increases in duration in proportion to body size in the course of phylogenetic and ontogenetic development. In the rat the "biological hour" equals 10 to 13 minutes, in the cat about 30, in the monkey 45, in man about 90, and in the elephant about 120 minutes. The BRAC lengthens from birth to maturity in all species exhibiting the cycle. In man it extends from 50 to 60 minutes in the infant, and from 85 to 90 minutes in the adult. Sterman and Hoppenbrouwers (1968) report the development of the rest activity cycle in the human fetus beginning the sixth fetal month. Fetal activity was detected in the fifth fetal month, and it became cyclic during the sixth. Measurement from the beginning of one activity to the beginning of the next had a mean of 47.8 minutes. The cyclic time lengthened progressively to 62.7 minutes by the eighth month.

Battle (1970), in a review of sleep and sleep disturbances in infants, presents the following review of electroencephalographic events which occur during sleep:

> While a person is awake his EEG shows rapid irregular waves.

As he settles down to rest, the first of two wave patterns which occur during sleep emerges. The first pattern is the alpha rhythm—a regular wave pattern of low voltage with frequency of about 8 to 12 cps (cycles per second). The second wave pattern is the delta rythm which is of high voltage and has a slow frequency, 1 to 2 cps. Sleep spindles—sudden short bursts of sharply pointed alpha waves of about 14 to 16 cps—occur at certain stages in sleep.

By such EEG studies, four different stages of sleep have been identified:

Stage I (REM)	An irregular and low voltage alpha rhythm is present. The person awakened easily and often may deny he has been sleeping.
Stage II (REM)	Sleep spindles occur at intervals. The person is more relaxed but still may be awakened easily.
Stage III (REM)	Delta waves begin to occur and spindles are still present. The sleeper is much more relaxed; the vital signs begin to decrease. Now it is more difficult to awaken him.
Stage IV	This stage is deep sleep and delta waves are prominent. The sleeper is markedly relaxed and rarely moves. When awakened in Stage IV, a person responds slowly. Somnambulation and enuresis occur during this stage.

Traisman, Traisman, and Gatti (1966) in studying 530 infants found a wide variation in the longest sleep period during the first year of life. Infants sleeping in a room by themselves slept from .04 to .45 hours longer each night than infants sleeping in their parents' room. Infants who were thumb-suckers slept about one-half hour longer each night than non-thumb-suckers. Colicky infants slept from .04 to .83 hours less than non-colicky infants. The greatest difference in duration of sleep occurred at 3 months of age and disappeared by 1 year. See figures 14 and 15.

From the parents' standpoint the most important change in the infant's sleep pattern is the development of a diurnal cycle with most of the sleep at night and most of the wakefulness during the day. There is relatively little change in the total amount of sleep during the 24-hour period in infants and young children; the change comes in the pattern of the sleep-wake periods (Parmelee, 1964). In regard to the alternating pattern of sleep, an important maturation change is that the infant progressively develops more NREM sleep so that by about 3 months, half of the sleep is NREM and the other half REM.

The developmental characteristics of sleep can perhaps best be outlined by presenting the sleep section of the Washington Guide for Promoting Development in the Young Child (Barnard and Powell, 1972). The common characteristics of the child's sleep with regard to duration and the typical developmental phenomena occurring are presented:

Figure 14.—The longest daily sleep period during the first 2 years of life, including two standard deviations

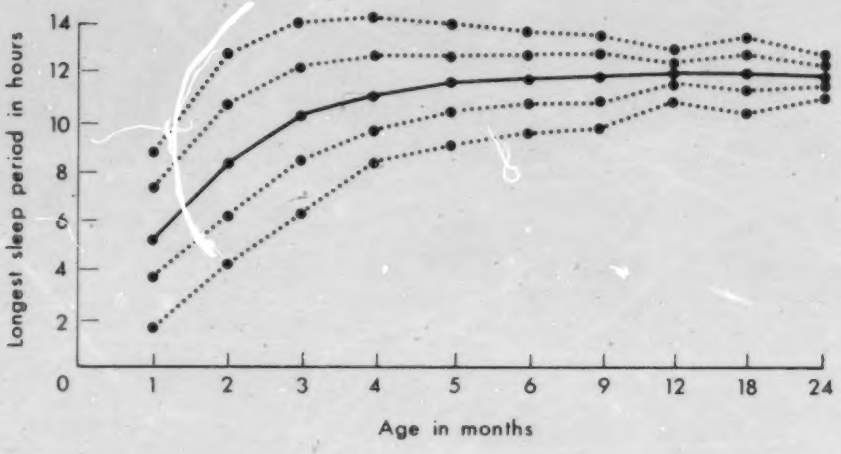
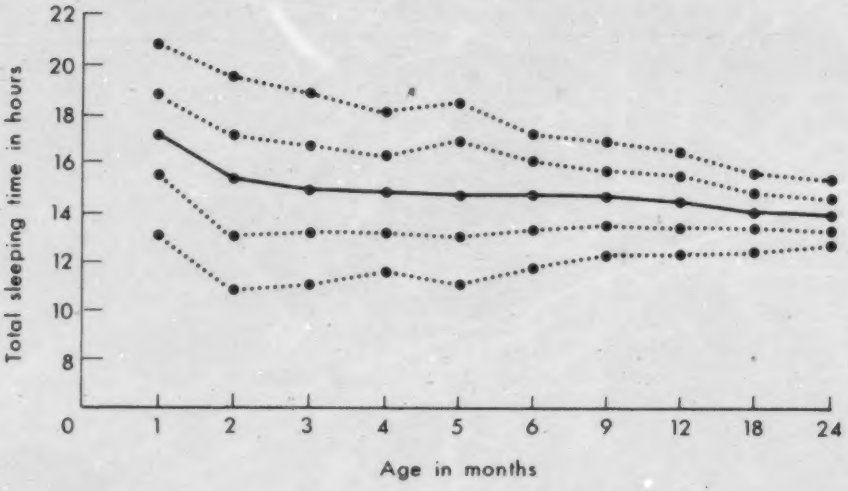


Figure 15.—The daily total sleeping time during the first 2 years of life for infants in this study, including two standard deviations



Expected Tasks

1-3 months
Night: 4- to 10-hour intervals
Naps: frequent
Longer periods of wakefulness without crying

4-8 months
Night: 10 to 12 hours
Naps: 2 to 3 (1 to 4 hours in duration)
Night awakenings

9 to 12 months
Night: 12 to 14 hours
Naps: 1 to 2 (1 to 4 hours in duration)
May begin refusing morning nap

13 to 18 months
Night: 10 to 12 hours
Naps: one in afternoon (1 to 3 hours in duration)
May awaken during night crying (associated with wetting bed)
As he becomes more able to move about he may uncover himself, become cold, and awaken

19 to 30 months
Night: 10 to 12 hours
Naps: one (1 to 3 hours in duration)
Doesn't go to sleep at once—keeps demanding things
May awaken crying if wet or soiled
May awaken because of environmental change of temperature, change of bed, change of sleeping room, addition of sibling to room, absence of parent from home, hospitalization, trip with family, or relatives visiting

31 to 48 months
Daily range: 10 to 15 hours
Naps: beginning to disappear
Prolongs process of going to bed
Less dependent on taking toys to bed
May awaken crying from dreams
May awaken if wet

49 to 52 months
Daily range: 9 to 13 hours
Naps: rare
Quieter during sleep

Sleep and Other Neurological Functions

Investigators whose studies have focused on early manifestations of neurological functioning in the infant particularly in the

premature have demonstrated that the ability to organize behavior is manifested in sleep patterning. Normal cyclic patterns of sleep, abnormal durations of sleep states, and the lack of correlation of various behavioral and physiological parameters have been demonstrated in sleep patterns of premature infants (Dreyfus-Brisac, 1965, 1968, 1970; Parmelee, 1967, 1970). There is also evidence from retrospective data that sleep disturbances are common in the premature population. Drillien reports an incidence of 25 percent of the population she studied had sleep disturbances through 2 years of age (Drillien, 1964). As early as 1926, Tracy, in a study of the fish embryo, suggested that spontaneous movements in the embryo represented a periodicity of spontaneous movement that might persist and determine the general level of motor activity in the adult. The established pattern of disorganization in the premature's spontaneous behavior as reflected in his sleep, raises the issue of how early the pattern of inability to organize behavior contributes to the significant incidence of learning problems manifested in the premature population.

Feinberg presents the sleep cognition hypothesis. He states that sleep variables and certain information-processing capacities of the brain show parallel variation with age and with organic brain disease. Such a relationship suggests two main possibilities. The first is that both sleep and cognition, being complex processes, may suffer to a similar degree by brain lesions, although they are not fundamentally related. Second, a more interesting alternative is that parallel changes in these processes occur because they are intrinsically related and because during sleep the brain is actively carrying on certain processes complimentary to and required for waking cognition (Feinberg, 1969). In a relatively recent study by Feinberg, Braun, and Schulman (1969), it was demonstrated that rapid eye movement sleep measures were quantitatively related to the level of intellectual function in mentally retarded subjects. A correlation coefficient of 0.73 was found in intelligence scores and percentage of eye movement sleep. It is possible that the basis for this positive correlation between rapid eye movement sleep and intelligence is that during sleep the brain carries out certain processes that have to do with the repair or erasure of synapses. Feinberg's findings of less rapid eye movement sleep in mentally retarded subjects are consistent with those of Goldie, Curtis, Svendsen, and Roberton (1968).

Schulman (1969) in a study of the sleep cycles in heroin addicted and neurologically suspect newborns reported that in neither experimental group was the criterion for quiet sleep met. The criterion was to find the presence simultaneously of high voltage

low-wave EEG activity, significant decrease in heart rate variability, absence of body movements, and absence of rapid eye movements. A normal sleep cycle showing an alteration between active and quiet sleep as defined was absent in the experimental subjects. The results of this study indicate, as has been suggested, that the sleep cycle of the newborn infant is a highly sensitive indicator of the presence of events which affect the central nervous system.

Parmelee (1970) speculates that detailed knowledge of the stability and duration of the quiet sleep component of an infant's sleep cycle could allow us to predict his capacity to sustain attention, this being an important aspect of behavior, in that it would allow us to predict learning potential as it related to the function of attention. Several investigators (Parmelee, 1964; Despert, 1949; and Dargassies, 1972) have found in a general appraisal of infants that disturbed sleeping habits are often a sign of a neurodevelopmental disorder in young children.

Common Sleep Difficulties in Children (Battle, 1970)

The normal sleep difficulties of the infant relate to the phases of getting to sleep and awakening during the night. The infant generally develops behaviors, such as thumb-sucking and rocking, which help him achieve sleep. Often changes in family routine or colic are explanations for disturbances in an infant's sleep pattern. The child during the second year of life demonstrates increasing difficulty about going to sleep. The matter of going to bed is prolonged, and the child typically establishes a host of rituals that must accompany bedtime. Changes in these rituals are most upsetting to the child, and he resists sleep more strongly. It is common for the 3-year-old to have night awakenings. Again, as with the infant, the child often learns to handle this on his own with quiet play and then falling back to sleep. In addition to those age-specific characteristics, it is common for children between 1 and 4 years of age to engage in head-banging and rocking behavior, and around 2 or 3 years of age to begin to demand more of mother's presence at bedtime, to have bedtime fears, dreams, and nightmares.

Illingworth (1966) has indicated that often parental overanxiety or environmental physical adversities such as noise and cold are responsible for sleep problems in the younger child, while he cites a lack of permissiveness to often be responsible for problems in the older child.

Sleep Problem Definition

The theoretical importance of sleep, the typical development of

sleep patterns and disturbances have been described; what then can be classified as a sleep problem about which the professional person should be concerned? Moore and Ucko (1957) have defined a sleep problem as, "a situation when the child awakens its parents during the night, wakes up and cries and fusses between midnight and 5 a.m. at least once a week." Ragin's study with mothers of 2-year-old children attempted through careful interview to document and determine what constellation of symptoms constituted a sleep problem. They were not able to differentiate any particular constellation of symptoms, however they did conclude that when a mother expresses ongoing concern about her child's sleep, it is a significant indicator of psychopathology.

Consistent with these definitions, a more definitive statement of criteria defining a sleep problem are:

1. a child who has not been able to maintain an 8-hour sleep duration after 3 months of age;
2. a child for whom the parents feel sleep is a problem;
3. a child with recurring problems (more than three times a week) of getting to sleep for naps or night sleep.

The most practical method of obtaining the child's sleep history is to ask the parents. A profitable beginning question is: "Have you ever been worried about the child's sleep?" (Ragins, 1971).

In addition, data reflecting the duration and pattern of sleep periods can be asked. A description of the child's daily sleep routines which includes sleep times, awakenings, reactions, and where the child sleeps, provides information which will assist in identifying children with sleep problems.

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Chapter 9

Childhood Accidents

A great deal of money and medical research has gone into the cure and prevention of childhood diseases. The primary result has been a dramatic decrease in mortality among children, but the success of this effort has had another, less well-known side effect: It has at last brought to national attention the problem of accidents as a prime cause of injury and death.

Magnitude of the Problem

Despite the cost in terms of life, health, happiness, and economic resources, most Americans are still unaware of or apathetic toward the true scope of the tragedy. People of all ages are affected, but a disproportionate share of the losses belong to the aged and the young. Since this chapter is concerned primarily with the latter, the statistics and studies presented focus on children under the age of five.

Fatal Accidents

According to McFarland and Moore (1971, p. 350), accidents rank sixth after immaturity, postnatal asphyxia, congenital malformations, pneumonia, and birth injuries as the cause of death of infants up to 1 year old. But after that age, accidental death jumps far ahead of other causes. Government figures for 1969 on the major causes of death in children 1 to 4 years of age (U.S. Department of Health, Education, and Welfare, 1972) show that accidents account for approximately 36 percent of deaths, followed by congenital anomalies (about 12 percent), influenza and pneumonia (almost 10 percent), and malignant neoplasms (about 8 percent). Lesser categories, such as meningitis, homicide, major cardiovascular, heart, and renal diseases, and diarrheal diseases each account for less than 3 percent of deaths (total deaths age 1 to 4 years: 12,290).

The distribution of fatalities by age, sex, and type of accident is shown in table 6. The most complete data available is for the year 1969. The 1972 totals for each category support the overall trend of the earlier data.

Table 6.—Fatalities from leading types of accidents in the United States, classified by age and sex. 1967[1]

Type of fatal accident	Age						
	Under 1 year	1 year	2 years	3 years	4 years	Total under 5 years	Total 0–4 year for 1972[2]
Motor vehicle							
Total	321	367	484	464	431	2067	1900
Male	159	201	275	293	158	1186	
Female	162	166	209	171	173	881	
Fires and explosions							
Total	189	242	244	258	199	1132	900
Male	92	129	136	155	107	619	
Female	97	113	108	103	92	513	
Drowning							
Total	68	252	215	174	130	839	850
Male	39	147	160	131	99	576	
Female	29	105	55	43	31	263	
Inhalation or ingestion of food or objects							
Total	620	104	38	25	15	802	900
Male	366	67	22	18	6	479	
Female	254	37	16	7	9	323	
Falls							
Total	163	136	86	53	40	478	300
Male	93	78	48	39	24	282	
Female	70	58	38	14	16	196	
Poisoning by solids or liquids							
Total	45	151	73	36	20	325	200
Male	25	83	34	21	12	175	
Female	20	68	39	15	8	150	

[1]Selected data from *Vital Statistics of the United States*, 1967. (McFarland and Moore, 1971, p. 352.)
[2]Selected data from *Accident Facts*, 1973. (National Safety Council, pp. 6–7.)

These data indicate that, with very few exceptions, males outnumber females across the board—at all ages and for all types of accidents. Other trends are also visible. Deaths from different types of accidents reach their peaks at various points on the age continuum. For example, poisoning is most frequent among 1- and 2-year-olds and declines steadily thereafter; babies under 1 year succumb most often from ingesting or inhaling food or other objects, but after the first year this category of accident ranks lowest; deaths from falls (usually from high surfaces where infants were placed) also peak in the first 2 years and then decline steadily. In contrast, the number of motor vehicle fatalities is consistently high for all ages shown. It is evident that the victim's level of physical and social development, as well as his active or passive participation, affect these patterns.

Nonfatal Accidents

Fatal accidents are, of course, far outnumbered by nonfatal ones, and the resulting injuries vary in seriousness. The ratio of serious injuries to deaths may be as high as 100 or 150 to 1. On the basis of figures from the Health Interview Survey (U.S. Department of Health, Education, and Welfare, 1967), it is estimated that 8,922,000 children under age 6 each year receive injuries which require medical attention or restrict their activity for a day or more. Or to state it another way, 38 of every 100 children in this age group are injured to the extent defined by the survey: an accidental injury is one which results in hospitalization or requires three or more outpatient visits or restricts activity for more than 1 day. Matheny, Brown, and Wilson (1972, p. 437) state that perhaps as many as 50,000 children under 14 years are permanently injured each year in nonfatal accidents.

A prime source of information on this subject is a massive study by Manheimer, Dewey, Mellinger, and Corsa (1966), who examined records of more than 13,000 medically attended injuries. The 8,874 California children studied were covered by a prepaid medical plan for as long as 4 to 15 years per child. The study examined the whole population at risk, for a total of 53,448 "child years." They analyzed types and severity of injury, what body parts were affected, and major categories of accident. Injury rates were obtained for the total group as well as for subgroups by age, sex, race, and sibling order.

Their results are too complex to describe in detail here, but certain trends deserve highlighting. Like the data on fatalities, their findings show that boys were more involved in accidents than girls in all age groups. The rate of boys' injuries, especially

severe ones, increased with age; whereas girls were hurt most often in the first 4 years, with declining frequency after that period. Socioeconomic factors are revealed in the finding that children with "professional" fathers had the highest accident rate, while children of semiskilled or unskilled fathers had the lowest. Although white children ranked above Negroes and Orientals in accident frequency in this study, other research has shown that black children incur a disproportionate number of injuries. McFarland and Moore (1971, p. 356) hypothesize that a socioeconomic bias related to ability to participate in a prepaid plan may partially account for this discrepancy.

In terms of types of injuries, Manheimer et al. (1966, p. 528) show lacerations heading the list with an annual rate of 63.8 per 1,000 children, followed by contusions (45.5), sprains and strains (30.8), abrasions (27.9), perforations (21.6), and fractures (21.4). Although burns (9.5) and concussions (2.2) occurred less frequently, they were more serious (27.3 and 40.3 percent of cases, respectively, were severe). Fractures were considered severe in 73.5 percent of cases studied, receiving the highest ranking for severity.

As it was for fatal accidents, age was an important influence on the distribution of types of injury and on what body parts were affected. For instance, rates for burns and poisonings were highest among children under 4 and then decreased; lacerations remained frequent through age 8, declining thereafter; children in the 12 to 15 age range experienced several times as many sprains and fractures as did children under 4. The head was the part most often injured, although the rate of head injuries fell rapidly between the ages of 4 and 12.

Table 7 shows the relationship of accident type, rate of injury, and severity.

Several of these accident categories deserve specific amplification in relation to young children. Summarizing the findings of a number of studies, McFarland and Moore (1971) state that rolling off surfaces where they have been placed causes most of the falling injuries to young infants, but among older children climbing over the sides of the crib is the most common cause of injuries due to falls. Scalds from hot liquids and burning clothing are responsible for most burns of young children, and nearly all of these are incurred in the kitchen of their home. About 90 percent of poisoning cases involve children under 5 years of age, most frequently those between 18 and 24 months. The type of product ingested seems to be a function of several factors, including socioeconomic status, cultural patterns, and geography.

Table 7.—Type of accident resulting in medically attended injuries—annual rates per 1,000 children for all injuries and for severe injuries, and three measures of severity for each type of accident

Type of accident	Rates[1]		Percent of type severe	Average number of physician visits	Percent of type resulting in hospitalization
	All injuries	Severe injuries			
Fall	56.8	11.9	21.0	1.8	4.5
Contact with sharp or rough object	20.2	2.6	8.8	1.4	.7
Collision with person or object except vehicle in motion	22.7	3.6	16.0	1.6	2.2
Dog bite	13.4	.6	4.8	1.2	.2
Struck by falling, flying, or thrown object	10.2	2.1	20.2	1.7	2.7
Bicycle or other pedal vehicle	9.5	2.7	28.7	2.0	6.5
Caught in, pinched, crushed	8.2	1.3	15.2	1.6	1.3
Contact with hot object or substance	6.7	2.0	29.8	2.1	3.5
Motor vehicle	6.2	1.2	19.5	1.7	9.7
Occupant	4.4	.7	15.9	1.5	6.4
Pedestrian	1.8	.5	28.6	2.1	16.7
Ingestion of poison[2]	6.2	.5	7.3	1.1	6.8
Suffocation	5.8	.4	6.6	1.2	5.2
All injuries[3]	246.1	37.4	15.2	1.6	2.6

[1]Based on only those injuries with information as to type of accident. Since for fully one-fifth of the injuries the accident type was unknown, rates underestimate actual incidence of accidents in the study population. Rates are standardized for age for the 8,874 study children.

[2]Includes all cases of actual or suspected aspiration or ingestion of poisonous substances.

[3]The data presented for "All injuries" include miscellaneous accidents as well as those for which information was not obtained.

Source: (Manheimer et al., 1966, p. 528)

Effects of Injury

Clearly, the physical results of accidents are important. Long-lasting or permanent bodily damage may affect the child's health and functioning for life, and considerable research has been done to improve rehabilitation methods. But much less attention has been given to the social, psychological, and even economic consequences of serious accidents for both the child and his family. Suchman and Scherzer (1964, p. 284) state that "the extent of group support or disapproval of accidents and the accident victim will affect the course of the adjustment. The accident potential of individuals who have had accidents may be increased or decreased by their ability to learn from the accident and by the meaning the accident has for them." The child's self-image and future behavior may be affected by feelings of guilt or inadequacy, by a change in his parents' behavior toward him, or by a label of "accident-prone." Parents may feel angry or guilty about the accident and may even punish the child. The cost of medical care may be a burden to the family and create further problems. The literature reveals little information on these possibilities. Although some reports describe negative feelings associated with accidents, no studies could be located which systematically investigated the psychosocial adjustment of the child and his family to an accident. Such research is needed.

Research: Models and Methods

Accident research has only recently become an independent and scientific discipline. A major barrier to the investigation and prevention of accidents is the fatalistic belief, long held by both laymen and professionals, that accidents are just chance occurrences or acts of God. This apathetic or tolerant attitude has tended to limit public support for research efforts. Another limiting belief is that accidents result predominantly from human misaction, and therefore, since injury results from accidents, the only way to avoid injury is to prevent accidents by changing human behavior (Waller and Klein, 1971).

An important step in the scientific attack on unintentional injury was made by Gordon (1949), who proposed that the methods used to study the causes and distribution of diseases could also be applied to analyzing accidents, and who suggested that causation of injury is "a combination of forces from at least three sources—the host, the agent, and the environment in which host and agent find themselves" (p. 506). This epidemiological approach proved fruitful, especially after Haddon (1967) showed

that the true agent in this triad is some form of energy—thermal, electrical, kinetic, and so on. McFarland and Moore (1971, p. 359) elaborate Haddon's concept: "Accidental injuries result from (1) the application of various forms of energy to the human body in amounts exceeding the tolerance thresholds of its various parts, and (2) interference with the normal exchanges of energy between the body and its environment (e.g., in drowning). . . . The energy which impinges on the body is delivered by various means, usually by inanimate objects. These correspond to the 'carriers' or 'vectors' of disease. . . . Also, the variation in natural or acquired resistance to injury corresponds to resistance to infection."

Thus, efforts to predict and prevent unintentional injury must encompass the complex interrelations among these factors. In examining the host, one might ask: What characteristics—such as age, sex, level of motor or intellectual development, physical condition, personality or behavior traits, experience or training—are most significant in his (or her) involvement in an abnormal exchange of energy or his susceptibility to injury? In examining the agent and its environmental source or carrier (cars "carry" mechanical energy, hot stoves carry thermal energy), other questions are pertinent: Does it have enough stored or transformable energy to cause injury? How much human knowledge or skill is required to operate or contact it safely? Is it new or unfamiliar to its user? Can it be modified so that when energy is released the damage to tissues will be lessened? What socioeconomic factors affect the type of energy sources used and how people handle them? Other aspects of the environment, such as different types of child-rearing (permissive versus restrictive, and so on) also affect the child's exposure to energy transformers. (An excellent theoretical overview of these issues is available in Waller and Klein, 1971).

Two methodologies predominate in the field of accident research: (1) the "descriptive epidemiological approach" which looks at who, where, when, how, and what by gathering data from large groups and identifying high-risk populations; and (2) the "investigative epidemiology approach" which focuses on individual cases by making interdisciplinary and in-depth studies of causation. The Manheimer et al. study cited earlier is a good example of the first; it shows how certain variables—age, sex, and so on—are associated with type of accident and location of injury. However this information does not help much in identifying particular children who are at risk of injury.

Individual Behavioral Characteristics

Several studies have examined the concept of the accident-prone child. In a retrospective study of behavioral characteristics of children with varying degrees of accident liability, Mellinger and Manheimer (1967) found that accident-proneness involved two concepts: exposure to hazards and the ability to cope in a hazardous situation. Behavioral traits identified as variables likely to increase exposure to hazards included high activity level, extraversion, and the degree to which a child is adventuresome and exploratory. Traits which may impair a child's ability to cope were identified as follows: "...the child who is aggressive, competitive, impulsive, stubborn, or easily frustrated will be less likely to cope with hazards successfully than the child who lacks these traits, either because the former is so intent on what he is doing that he does not recognize hazards ,or because his other motivations are stronger than his need to avoid injuries." (Mellinger and Manheimer, 1967, p. 99).

A study of 49 pairs of twins of the same sex (Matheny, Brown, and Wilson, 1971) is particularly interesting because the twins' behavioral differences were analyzed before they had had any accidents. When the twins were a year old their mothers were asked to "identify behaviors related to temperament, socialibility, aspects of cognitive development, similarities or differences between the twins, and, when noted, which twin was perceived as displaying the behavior more prominently. . . . The three variables selected were . . . temper frequency, attention span during play, and amount of spontaneous, general activity (p. 123). Analysis of the serious accidents (those requiring medical attention) reported by the mothers in subsequent interviews showed that "the twins with more accidents had been more active, temperamental, and less attentive than their co-twins at 1 year of age" (p. 124), and general activity was the variable most associated with frequency of injury.

These findings support the theory of accident-proneness and indicate that predictive behaviors can be identified in early childhood. In a later article, Matheny, Brown, and Wilson (1972, p. 438) present a checklist of individual behavioral characteristics related to accident liability: (1) The child who is, for example, daring, excessively curious, happy-go-lucky, unable to delay gratification, and easily overstimulated is more apt to be exposed to hazards; (2) Aggressiveness, lack of self-control, poor attention, stubbornness, and "hot-headedness" are some characteristics associated with reduced ability to cope with hazards.

Environmental Factors

Older research on the child's social environment has focused on such influences as pressure to maintain peer status, social and cultural norms that help to determine what activities are engaged in by children of different ages and sex, and variations in child-rearing practices and level of family knowledge—or ignorance—of safety practices.

More recently, the quality of the parent-child relationship and other patterns of family life have gained attention. According to the "vulnerable family" concept developed by Backett and Johnson (1959), significantly more injured children come from families having one or more of these characteristics: supervised, protected play areas are lacking; the mother or another family member is ill, probably seriously; the mother is preoccupied with other children, pregnancy, or outside employment; and there is a relatively high number of dependents per earner in the family. Similarly, Meyer, Roelofs, Bluestone and Redmond (1963) found that accidents were often associated with stresses in the family and with a reduction in supervision just before the injury occurred.

Perhaps one of the best multidisciplinary studies was done by Wight (1969). The total population comprised 250 children who were X-rayed because they had received some kind of physical blow. They and their (164) families were examined in depth, using social interviews, pediatric exams, psychosocial tests, and observations of parent-child interactions both at home and in the hospital. Seventy-seven cases (including 16 cases of suspected child abuse) were followed for a year, with the intent to find out whether particular characteristics of the child, the home environment, and family interaction could be correlated with certain types of accident situations. "Child-active" accidents—in which the child's activity in the environment results in the blow—were subdivided into "open-field" (child crawling, walking, colliding with furniture) and "fall" cases (falls from dressing tables, for example). "Child-passive" accidents—those resulting from activity of people or objects in the environment—were divided into "dropped," "struck," (hit by another person), and "unusual," (hit by baseball, struck by collapsing baby equipment, knocked out of mother's arms by dog).

The two main classifications were found to differ along several dimensions: (1) The child-active, "open-field" children were more motoric and negativistic and had atypical sleeping and eating habits; their development was relatively accelerated; they came primarily from non-lower-class families; their mothers

tended to seek medical attention early, were more responsive verbally to their children's behavior, and did not see any particular kind of behavior as meriting punishment. (2) In contrast, children in the "child passive" category were considered easier to manage and showed moderate activity levels and less deviation in behavioral patterns; those in the "struck" and "unusual" subgroups appeared to be bland, apathetic, and developmentally retarded (becoming more so during the followup year); they came primarily from low socioeconomic backgrounds and experienced many family disruptions and stresses; their mothers tended to delay seeking treatment, to punish demanding or disobedient behavior, and to be hostile or guilty about the accident. The research report hypothesized that the lower verbal responsiveness found among all three types of "child-passive" mothers may be related to the persistent developmental retardation of the "struck" and "unusual" children.

Although most studies of family and social influences are fairly subjective, methods for testing and measuring social behavior are improving. As our understanding of the complex causation of accidents also improves, we are faced with the even more difficult task of applying this knowledge to predicting and preventing individual occurrences and or reducing the severity of injury.

Summary

It seems clear that childhood accidents are not just acts of fate. They occur with greater frequency in certain kinds of families and to certain kinds of children. A serious childhood injury is thus an outcome of a host of interrelated variables. But it must also be remembered that the fact of an accident and the accompanying family disruption or possible permanent injury to the child then become predictors of later family interactions. Thus, a 1-year-old who has already experienced several accidents, even if he now appears quite normal physically, mentally, and emotionally, may well be considered at high risk because of what the accident record suggests about the child and about the characteristics of family interactions.

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Chapter 10

Language

Failure to acquire language, or a disruption of the language acquisition process, is one of the most devastating and isolating events which can occur to a human being. Results of such disruptions can and do have far-reaching educational and societal implications. There is ample evidence to show that there are great numbers of children who for one reason or another have not achieved a level of language acquisition which permits them to enter fully into the life of the community. That there are such children has led to a search for techniques of assessment and treatment by which the impairment of communicative function can be alleviated. If this goal is to be achieved, those concerned with disabilities of language should have some understanding of the structure of language in order to be better able to assess and treat the child with a language impairment. (O'Malley and Tikofsky, 1972 p. 3.)

Definitions

Language has been defined by Carroll (1967) as a code or system which speakers have learned. The code includes four distinct aspects: (1) phonology—the specification of units of sound (phonemes) which go to compose words and other forms in language; (2) morphology—the listing of words and other basic meaningful forms (morphemes) of the language and the specification of the ways in which these forms may be modified and placed in varying contexts; (3) syntax—the specification of the patterns in which linguistic forms may be arranged and the ways in which patterns may be modified or transformed in varying contexts; (4) semantics—the specification of the meanings of linguistic forms and syntactical patterns in relation to objects, events, processes, attributes, and relationships in human experience.

Factors Influencing Language Acquisition

Those concerned with communication—both normal and abnormal—have long recognized certain prerequisites to communication. The following description seeks to summarize these variables which affect the acquisition of language under the broad categories of congenital biological factors, maturational factors, and environmental factors:

A. Congenital Biological Factors

1. Anatomical and Physiological functions

a. Receptive
   (1) Acuity
   (2) Discrimination
   (3) Symbolic association
b. Expressive
   (1) Discrete movements
   (2) Motor patterning
   (3) Semantic association

2. Central processing
   a. Intelligence
   b. Categorizing
   c. Problem solving, etc.

B. Maturational Factors
   1. Neuromuscular "readiness"

C. Environmental Factors
   1. Adult language models
   2. Child rearing practices
   3. Peer group interactions
   4. Emotional development

Congenital biological factors: At birth, a child possesses a potential for language learning in terms of certain anatomical and physiological systems as well as intellectual capacity. These factors are included in this category even though they may be influenced subsequently by other variables after birth.

The successful use of oral language is obviously dependent upon the ability to receive and to produce speech stimuli. Since comprehension of language precedes the development of expressive language, an intact and functioning auditory system is basic to language learning. The receptive-expressive language concept implies a time sequence in language acquisition as well as the necessity of the receptive component for the development of expressive language. Thus, dysfunctions of the auditory mechanism will interfere with the child's reception of oral language and, thereby, impede his acquisition of expressive language. The basic processes of the receptive mechanism include: (1) acuity, (2) discrimination, and (3) symbolic association. Thus, reception would break down if (1) the ear could not detect the auditory signal (acuity), (2) the ear could not discriminate differences in loudness, quality, and pitch (discrimination), or (3) the semantic significance of an auditory symbol could not be established (symbolic association).

On the expressive side, an intact and functioning production system is necessary for the use of oral language. The basic processes of the expressive mechanism include: (1) discrete move-

ments, (2) motor patterning, and (3) semantic association. Expressive language disorders may result due to (1) motor impairments of the peripheral speech apparatus (discrete movements), (2) impairments in the ability to voluntarily "associate" the motor patterns of speech with specific movements of the peripheral speech structures, and (3) the inability to express thoughts into speech (semantic association).

The potential intellectual capacity with which a child is born has been found to influence the rate, quantity, and quality of language performance (Carroll, 1961; Irwin, 1952). While the relationship of cognition to language is complex, Lenneberg (1967) has emphasized the importance of certain types of cognitive functions as prerequisite to language development. A presumed intelligence factor, as measured by conventional IQ type tests, can be shown to be a prerequisite for normal language usage. At the low extremes of intelligence, language may not develop. Specific functions of the central processing system which are thought to influence language acquisition include categorizing, problem solving, etc.

Maturational factors: Lenneberg (1966) has proposed that the maturation of certain "brain centers" is necessary to produce a state of neuromuscular, sensory, and conceptual "readiness" in which the child shows rapid development of oral language. Carmichael (1964) suggests that this "readiness" is most likely a characteristic of quite specific brain mechanisms. Normal acquisition of language, thus, is dependent upon maturation to the state of "readiness" followed by a sequence of developmental advances. Premature infants have been found to be inferior (as compared to full term infants) in certain aspects of their language development. It has been hypothesized (de Hirsch et al., 1964) that delayed language development in premature infants is due to neurophysiological immaturity.

It appears that heredity and maturation account for the appearance of early oral behaviors such as babbling at 6 to 9 months since these behaviors occur even in deaf infants and in the absence of environmental language stimulation. The appearance of later developmental advances, such as the first word at approximately 1 year, appears to be the result of the addition of a third variable, environmental stimulation.

Environmental factors: The contention that environmental factors have an increasingly important influence on the rate and level of language development during and after the babbling stage has been supported by data summarized by McCarthy (1954b). Many studies have concluded that language is superior in quantity

and quality in the upper socioeconomic levels (Deutsch, 1964; Hess et al., 1965; Olim et al., 1965; Brainin, 1964). While socioeconomic status may be thought of as an intervening variable between environmental factors and language development, it is more significant to define those specific characteristics of family patterns and parental-child interactions which influence subsequent language behavior in children.

The significance of the parental or adult model is emphasized in the findings of Brown and Bellugi (1964). These researchers have reported evidence that children whose parents "expand" a great deal, i.e., repeat the speech of their children and, in so doing, change the children's sentences into the nearest well-formed adult equivalent, show more rapid acquisition of language than children whose parents expand little. Studies by Davis (1937) and Smith (1935) also have emphasized the importance of adult language models as an influence on the rate and level of language development. These researchers have corroborated the observation that children who associate mainly with adults use longer and more complex sentences than those who interact mainly with peers.

Certain child-rearing practices and parental attitudes also have been found to influence language development. Marge (1965a) reported data suggesting that permissive mothers tend to have children who attain higher levels of language maturity than those from restrictive homes.

Emotional disturbances in children which produce anxiety, feelings of insecurity, or deficient self-concepts are found to be basic components in many types of distorted interpersonal verbal communications. Deficits in expressive and receptive language are associated with neurotic and psychotic disorders in childhood. Stuttering in young children, for example, has been associated with maternal compulsiveness, overprotection and covert or overt rejection (Kinstler, 1961; Moncur, 1963). Nonverbal communication also has an important effect on the natural growth and progression of language. Eisenberg and Kanner (1956) noted the hesitancy of parents of autistic children to interact physically with the young infant, and considered this a critical factor in the emotional response lag of the autistic child.

Significance of Language in Relation to the Child's Development

A language disability can affect many aspects of a child's life. Failure to attain skill in language usage may hinder the child's

overall learning capacity. Several experiments have demonstrated the importance of language in cognitive areas such as concept formation, problem solving, thinking, and learning (Carroll, 1961; Mussen, 1963). Related to intellectual and cognitive development is the effect of a language disability on academic progress. In school, the child may suffer in activities such as reading and writing. He may experience academic retardation in many areas in primary and elementary school due to the value which many classrooms place on the child's ability to use language in formal and informal discussions between teachers and students (Bangs, 1968).

Emotional and social problems may develop in the child with a language disability. Situations which require communication with adults and peers can result in frustrations and feelings of failure (Frostig and Maslow, 1968; McCarthy, 1954a).

Incidence and Prevalence of Language Disabilities

Studies on the incidence and prevalence of language disabilities in the total population are few and often confounded by the use of different definitions of language disability and methodology. In reviewing studies on the incidence of speech and hearing disorders, Marge (1965b) points out that extrapolations from these small population studies to the general population must be done with caution and tolerance of broad error. In order to more accurately define the magnitude of the problem, the United States Office of Education has funded a long-term study of the prevalence of speech, language and hearing problems in school-age children (Hull and Timmons, 1966).

Table 8 shows Marge's classification of the findings related to oral language disabilities according to three types: (I) Failure to acquire any language, (II) Delayed language acquisition, and (III) Acquired language disability. He cautions that, to achieve his estimates, he has pooled and *reclassified* data from studies of handicapped populations which classified disabilities according to primary etiological factors. And, he points out the fact that he has made two challengeable assumptions: "that failure to acquire any oral language by age 4 years is a rare event" and "that almost all acquired language deviations (type III) resulted from conditions of adventitious hearing impairment and neurological deficits." In further explanation of his suggested classification he describes the three types of language disability as follows:

> Type I language disability refers to children who fail to show any signs of acquiring the language of their speech community at age 4

years, when language maturity is normally achieved, to age 17 years which represents an arbitrary terminal age for school children.

Type II disabilities refer to children who have developed some language functions but are delayed in their acquisition when compared with their peers.

Type III disabilities include those children who have acquired normal language function, but who then suffer a reduction in the use of their language. Generally, this category refers to children who have

Table 8.—Estimates of prevalence and incidence of oral language disabilities by type (ages 4–17)

Type of language disability	Current prevalance[1]	Incidence[2] (%)
I. Failure to acquire any language		
A. Age 4	A. 22,854[3]	A. 0.6
B. Ages 4–17	B. 44,745[4]	B. 0.08
II. Delayed language acquisition	3,467,784[5]	6.2
III. Acquired language disability	139,830[6]	0.25
Total	3,652,359[7]	6.53

[1]The total population of children age 4 through 17 years in the United States for 1969 was 55,932.000. (U.S. Government Bureau of the Census, 1969).

[2]Incidence estimated by dividing the total number of children in the United States, for specific age range, into totals under each type of disability.

[3]Represents total number of children estimated to have failed to acquire any oral language function by age 4. Includes 100 percent of profoundly mentally retarded, 90 percent of severely mentally retarded, 10 percent of congenitally deaf, 25 percent of emotionally disturbed.

[4]Represents total of children estimated to have failed to acquire any oral language function between ages 4 and 17. Includes the total in footnote 3 and the following: 100 percent of children 5 to 17 who are profoundly mentally retarded and 25 percent of children 5 to 17 who are severely emotionally disturbed. It is assumed that almost all the deaf, all the seriously mentally retarded, and most of the severely emotionally disturbed who were included under footnote 3 will have realized some language acquisition by puberty and are, therefore, classified under Type II disabilities.

[5]Represents 10 percent of severely mentally retarded, age 4, and 100 percent of severely mentally retarded, ages 5 to 17; 100 percent of moderately mentally retarded and 80 percent mildly retarded, ages 4 to 17; 90 percent of congenitally deaf, age 4, and 100 percent of congenital hard-of-hearing, age 4; 100 percent of congenital deaf and hard-of-hearing, ages 5 to 17; 10 percent of emotionally disturbed, ages 4 to 17; 50 percent of specific learning disabilities, ages 4 to 17; and 95 percent of the speech handicapped (not included in other categories), ages 4 to 17.

[6]Represents total of 100 percent of adventitious deaf and hard-of-hearing, ages 4 to 17; 10 percent of speech handicapped, ages 4 to 17, primarily related to acquired neurological deficits.

[7]Total of (4 plus 5 plus 6.)

(Marge, 1972, p. 91)

suffered personality disturbance or neurological insult following trauma or disease. (Marge, 1972, pp. 90-92.)

Further, Marge (1972, p. 92) comments that table 8 "does not provide any information about the number of children who speak either a dialect or a foreign language and have experienced or will experience difficulty in achieving social and economic mobility in the major speech community. Of the entire population of nonwhite children in the United States, it is estimated that approximately 75 percent would fall into the category of those in need of language training in order to function in a society of standard English speakers." (R. Shuy, personal communication, 1969.)

The differential diagnosis of language disorders in childhood as summarized by Chase (1972, p. 123) is given below:

1. Hearing loss
2. Oral-area sensory deficit
3. Aphasia
   a. Acquired
   b. Congenital
   c. Developmental
4. Dyslexia
   a. Acquired
   b. Developmental
5. Minimal cerebral dysfunction
6. Psychosis of childhood (including early infantile autism)
7. Monsychotic functional behavior disorders
8. Epilepsy
9. Mental retardation
10. Environmental deficits (sensory, emotional, and cultural deprivation; inadequate or incompetent instruction)
11. (Normal variation)

Language Assessment in Early Childhood

The first year of life is considered an extremely important period with respect to the development of communication patterns and pre-language skills. For example, cooing and babbling appear to be a rehearsal for the child's first words, and smiling and eye contact perhaps the beginning patterns of communication. From the moment of the infant's first cry at birth, communication patterns and pre-language activity begins. According to Lenneberg (1967), pre-language development involves: (a) all sounds related to crying present at birth which undergo modifications during childhood and persist throughout life, and (b) sounds emerging at 6–8 weeks that merge into acoustic productions of

speech. These sounds begin with brief cooing sounds and usually follow the smiling responses. The development of smiling in the infant provides information about an important communication signal that establishes social bonding between mother and infant. Social smiling may begin as early as the third week of life. After 4 weeks the smile is predictable (Wolf and Feinbloom, 1969). Eye-to-eye contact is "an interchange that mediates a substantial part of the non-verbal transactions between human beings" (Robson, 1968, p. 92). By the fourth week true eye-to-eye contact is effective, for instance, in evoking a smile. Mutual visual regard is one of the earliest channels of communication available to the mother and infant.

Although broad stages of language development (such as crying, cooing, babbling, first words, and word combinations) have been identified for years, there is no systematic definition of the small progressive steps of language learning. Such a system would require that the scale of language testing follow a theoretical model of language development.

Current Language Assessment Tests

Rosenberg (1968) suggests that a satisfactory language device must be based on (1) knowledge of normal language development and (2) an adequate characterization of what is being developed, namely, adult language. Current tests, however, tend to be concerned with a narrow range of linguistic behaviors. This limitation is particularly evident in screening-type tests which are designed to assess language in addition to several other areas of the child's overall development. Due to time constraints, the assessment of language development in screening tests fails to be comprehensive. There are relatively few language test items at each age level.

Current tests which are designed specifically to evaluate language development also have serious limitations. Due to the problem of cooperation in the young child, many language tests resort to the informant-interview method. Tests which rely exclusively on the mother's report of the child's language behaviors must have carefully worded questions and interviewers trained to prevent biasing of information. This is necessary to insure validity in terms of the child's actual behaviors. Language tests which use direct observation of the child's language behaviors often lack specific instructions for stimulus presentation and response requirements. The reliability of such instruments is questionable since examiners may vary in their method of stimulus presentation and the criteria they use for evaluating responses. Another

limitation evident in some current tests which may adequately assess language functions in children over 1 year of age is that they ignore the important pre-linguistic skills in the first year of life.

Brief descriptions of some current language testing devices are given below:

The Utah Test of Language Development (Mecham, Jex, and Jones, 1967) is a comprehensive screening test of receptive and expressive language functions. The underlying purpose is to determine if a child is delayed in language functions, and if so, the language processes involved. The test may be administered to children above 1 year of age. There are 51 test items arranged in developmental age levels from 1 to 15 years.

The Denver Developmental Screening Test (Frankenburg, Dodds, and Fandal, 1967) is a screening test in which language is one of four developmental areas assessed. The items in the language area are either examiner-administered or scored on the basis of mother's report. The test may be administered to children from age 1 month to 6 years. In the language area there are eight test items (mainly of the mother report type) which are applicable for children from 1 to 12 months of age.

The Developmental Profile (Alpern and Boll, 1972) provides for a reliable screening of five areas of child development, including the area of communication. The instrument utilizes a structured-interview technique. The communication scale is designed to assess the child's expressive and receptive communication skills. The scale is arranged into age levels which proceed in 6-month intervals from birth to 3½ years and proceed thereafter by year intervals to 12½ years. In the communication level there is a total of 44 test items, six of which are applicable to children from 0 to 12 months of age.

The Verbal Language Developmental Scale (Mecham, 1959) is an extension of the communication portion of the Vineland Social Maturity Scale by Edgar A. Doll. The informant-interview method is utilized to provide a description of the child's communication behavior in the areas of listening, speaking, reading, and writing. Questions are asked of the informant so that the information obtained is not biased. There are 50 test items arranged in age levels from 0 to 15 years. Seven of these items are applicable for children under 1 year of age.

The Receptive-Expressive Emergent Language Scale (Bzoch and League, 1971) uses the interview method to assess language skills from birth to 36 months of age. The scale is divided into areas of receptive language and expressive language. The scale

is arranged into age levels which proceed by 1-month intervals from birth to 1 year, by 2-month intervals from 1 year to 2 years, and by 3-month intervals from 2 years to 3 years. Each of these intervals includes three receptive and three expressive language items. There is a total of 132 language test items. An experienced interviewer is required.

The Receptive, Expressive, Phonetic Language Scale (D'Asaro and John, 1961) uses mother interview and behavioral observation of the child to determine the child's level of achievement in three areas of language development (reception, expression, and phonetic skills). Items appropriate for children 4 weeks of age to 6 years of age are included. The scale was assembled from language items built into a variety of existing measuring devices for young children. The scale is arranged into monthly age intervals from 1 month to 12 months, with increasingly larger intervals up to 6 years. Each of the monthly age intervals up to 12 months includes one receptive language item and two or three expressive language items. Specific instructions for stimulus presentation and response requirements are not given.

What appears to be lacking in current tests is a comprehensive device designed to test a wide range of linguistic behaviors based on a knowledge of normal language development. In addition, a systematic means of assessing pre-language skills in the first year of life is needed.

An attempt to fulfill these requirements has been made by Hedrick and Prather (1970) in their development of the Sequenced Inventory of Language Development. The SILD was constructed on the basis of a theoretical model of the hierarchy of language behaviors. A preliminary study was conducted to test the hypothesized ordering of the behaviors that fit within the model or were generated from it. The items were collected from sources such as the REP Scale (D'Asaro and John, 1961) and the Denver Development Screening Test (Frankenburg, Dodds, and Fandal, 1967). Specific behavioral instructions were written for the stimulus presentation and the response requirements for these traditional language items. In addition, new items were formulated to test language behaviors needed for the hierarchy of the model. The items of the SILD are arranged into 3-month intervals from 3 to 48 months. There is a total of 236 test items. Items appropriate for children 3 to 12 months of age include 18 receptive language items and 22 expressive language items. The theoretical model on which the SILD is based is described in some detail below.

Model of the Sequenced Inventory of Language Development

The framework of the theoretical model on which the SILD is based includes a receptive language model and an expressive language model. These terms are operationally defined within the framework of the model.

The *Receptive Language Model* lends itself to a system that follows a presumed progression of complexity. This same system has been used in most of the existing language models (Osgood and Miron, 1963). The SILD model differs in that the authors have tried to include terms that attempt to describe the *behaviors* that are examined under such headings. Only items requiring a motor response are included in the receptive model. Those who have tried to build models realize that there are items, such as verbal responses to questions, which tap both receptive and expressive skills. These items have been arbitrarily placed in the expressive model because they require verbal responses, and they will be discussed in that section.

1. Awareness
   Items included in this section require observable response (turning to localize or looking toward the sound source) to sound of speech presented to the immediate environment.
2. Discrimination
   The child's ability to respond differentially to sound or speech stimuli is tested. This section progresses from mother's reports of differential response at home to the child's demonstration of discrimination of noisemakers and speech sounds within the testing situation.
3. Understanding
   The child demonstrates that speech has become meaningful by performing verbally directed tasks. This section progresses from correct response to speech (1) accompanied by gestures, (2) accompanied by situational cues, to (3) speech alone. The directed tasks change in both vocabulary and the length and complexity of the command.

The *Expressive Language Model* is more difficult to define. The presumed progression occurs within many different types of expressive behaviors, among which could be included linguistic, quantitative, operant and other psychological paradigms. The authors include five classifications in their model, three of which are types of expressive behaviors and two of which are types of expressive measurement. The three expressive behaviors include assumed levels of progression from motor to pre-symbolic vocali-

zation to symbolic vocalization. Within the two types of expressive measurements no levels of progression are used, although the processes tested change with age.

1. Expressive Behaviors
   A. Imitative behaviors
      Items included in this section require that the child repeat an immediately previous motor or speech event. This event is initially produced by someone other than the child. No known intervening stimulus occurs.
   B. Initiating behaviors
      These items include motor and speech behaviors that occur without any apparent relationship to a previous verbal event (antecedent events might be nonverbal environmental actions or objects or might represent some drive state of the individual). The antecedent event may be known or unknown but it is not a verbal event.

      The initiating test items are, in the main, composed of information obtained from the mothers. Children's verbal responses in a testing situation are predominantly responsive or in some cases imitative, rather than initiating.
   C. Responsive behaviors
      These behaviors include only vocal items, excluding imitation, which were preceded by and apparently related to vocal stimuli. Progression is from pre-symbolic to symbolic vocalizations.
2. Expressive Measurements
   A. Verbal output
      For all children 2 years and older, a 50-response language sample is obtained as described in Johnson, et al. (1963). From this language sample, quantitative and descriptive data are obtained. The quantitative data are measurements such as the mean length of response and structural complexity. The descriptive data include information about the emergence of the use of parts of speech such as prepositional phrases, adverbs, third person pronouns, etc.
   B. Articulation
      Articulation skills of children 2 years and above are assessed. The correct production of initial and final consonants in single words is listed in developmental order.

The individual items with the language scales are subdivided according to the factors of the behavior model described above. The specific factors that comprise the scales are shown in tables 9 and 10 below. The columns represent the factors of the two scales and the rows represent the levels of progression within the factors from motor or pre-symbolic sounds to symbolic vocalizations.

Table 9.—SILD items,[1] receptive scale

Levels of progression	Factors		
	Awareness	Discrimination	Understanding
Pre-symbolic sounds	X	X	NA
Symbolic vocalizations	X	X	X

[1]X = items included in the scale. NA = items not included in the scale; these were not included because they were deemed inappropriate to this scale or were behaviors considered untestable.

Table 10.—SILD item,[1] expressive scale

Levels of progression	Factors				
	Imitative	Initiating	Responsive	Verbal Output	Articulation
Motor	X	X	X	NA	NA
Pre-symbolic vocalization	X	X	X	X	X
Symbolic vocalization	X	X	X	X	X

[1]X = items included in the scale. NA = items not included in the scale; these were not included because they were deemed inappropriate to this scale or were behaviors considered untestable.

Summary

Language is of considerable importance in the emotional, social and educational growth and development of the child. Disruptions in the language acquisition process can be, therefore, extremely devastating for the child. The prevalence of language disabilities in the population would appear to justify inclusion of language evaluation in an assessment of the child's total developmental status.

A systematic way of assessing language skills in children from birth through 3 years of age is available in the Sequenced Inventory of Language Development. This diagnostic tool allows the examiner to determine an estimate of the child's level of language

functioning in the areas of receptive and expressive language. Used as a part of a battery of tests to assess the child's growth and development, this test would allow for early detection of language disabilities and hopefully lead to early treatment.

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Chapter 11

Mental Development

An exhaustive review of the literature on cognitive development, even covering only the first 5 years of life, is obviously beyond the scope of this collection of reviews. The topic, in its many facets, takes up over 800 pages in the most recent edition of Carmichael's *Manual of Child Psychology* (Mussen, 1970), and the reader is referred there for detail and for the broader theoretical discussions. In the present discussion, let us restrict ourselves to three things: (1) a brief presentation of methods of assessment of mental development now in frequent use, (2) a discussion of the various kinds of factors which seem to influence mental development, and (3) an analysis of the problem of prediction of mental development.

Methods of Assessment of Mental Development

Problems of definition: Obviously before one can devise an assessment procedure, it is necessary to arrive at a definition of what is to be assessed. Most broadly, "mental development" or "cognitive development" is taken to subsume the following: learning, reasoning, thinking, remembering, analyzing, developing concepts, and for some, language development. All tests which purport to assess mental development will touch on some or all of these skills. But by no means all tests do so in the same manner.

As Stott and Ball (1965) have pointed out, there is a basic disagreement among those who devise assessment procedures as to the fundamental nature of the *developmental* process. The most common tradition assumes that mental development is basically a quantitative process: increments of knowledge or skill are added either directly as a result of growth, or as a result of interactions with the environment. If one begins with such an assumption, then the problem of assessment is one of sampling the normally acquired skills at each of several ages, and comparing each child with the "normal rate of acquisition." This assumption underlies the vast preponderance of tests for assessing mental development in both infants and older children (Bayley, 1933, 1969; Kuhlmann, 1922; Griffiths, 1954; Terman and Merrill, 1937; Thurstone,

179

1938). There may be some dispute as to whether the mental assessment tradition indeed has much to offer to the understanding of mental development or the nature of what is being assessed. Rather, as Zigler (1966) has pointed out, the contribution of this approach may lie exclusively within the area of measurement of individual differences.

Alternatively, one may assume that mental development is basically a series of qualitative changes: the child does, of course, increase in skills and knowledge, but according to the qualitative concept, these are organized into new systems as development occurs. Each of these new systems is an outgrowth of the one which precedes it and, to assess a child properly, it is necessary to determine how far he has progressed along the series of stages of development.

Among those who have emphasized qualitatively changing sequences are Gesell, who thought the origin of the sequence was in embryological physiological maturation, and Piaget, who thinks that the sequence arises from the necessary alterations in the child's initial system which result from the child's interactions with the environment around him. Gesell did develop a kind of assessment procedure which would permit him to place each child on the sequence of development (Gesell, 1925, 1940). Piaget has not himself developed anything which might be called a mental scale, although of late, several of his American followers have begun to do so. Of these, the Infant Psychological Development Scale (IPDS), developed by Uzgiris and Hunt (1966), is perhaps the best known and most widely used. It includes tests which purport to designate the infant's maturity in regard to each of Piaget's six stages of sensorimotor development. Included are development of such phenomena as: (1) a concept of object permanence; (2) gestural and verbal imitation; (3) a repertoire of varied behaviors with which to interact with objects; (4) goal-attaining techniques such as the use of objects as tools; and (5) development of notions about causality and spatial relationships. As with the Gesell scales, the fundamental purpose of the Uzgiris and Hunt scales is to place each child at some level on the normal sequential pattern. Obviously one can talk about a child being "slow" or "fast" as compared with some criterion group, and such use has been made of the IPDS (Wachs, Uzgiris, and Hunt, 1971). But the scales are also designed to be used for diagnostic purposes, and they hold some hope of being more useful for diagnosis of specific difficulties than has been the case for the more widespread infant or childhood "intelligence" tests.

Instruments for measuring intelligence in infancy: The avail-

able tests, and the evidence relating to them, are well reviewed by Stott and Ball (1965) and Thomas (1970) and are not presented in detail here. Information on the more popular tests are summarized:

- Standard "quantitative" tests of infant mental growth

Bayley's California First-Year Mental Scale, first published in 1933 and revised in 1958 and 1969 as the Bayley Scales of Infant Development, is in increasingly wide use. The revised scale covers the age group from 2 to 30 months of age, and includes three sections: the Scale of Mental Development, the Scale of Motor Development, and the Infant Behavior Profile. The items in the Mental Scale include measures of "adaptive responses"; attending to visual and auditory stimuli, grasping, manipulating, and combining objects; social interactions with the examiner such as smiling or cooing; memory or awareness of object constancy, such as looking for a hidden toy; goal-directed perseverance; following directions, and use of language. The Motor Scale includes both fine and gross motor skills, such as holding the head up, sitting, use of pincer grasp, creeping, standing. The Behavior Profile, filled out by the examiner, consists of a series of ratings of general behaviors such as responsiveness to persons and toys, general happiness of the infant, endurance, and goal directedness. The raw scores on the Mental and Motor Scales are converted into a Mental Development Index (MDI and a Psychomotor Development Index (PDI).

The Gesell Developmental Schedules (Gesell and Amatruda, 1947) are traditionally very popular. They provide items beginning at approximately 1 month and extend through the sixth year, although the items beyond infancy are infrequently used. Items are classified into four categories: Gross Motor, including postural reactions, locomotion, balance, and other coordinated motor activities; Adaptive-Fine Motor, including alertness, fine sensorimotor skills, and various forms of constructiveness and exploitation of objects; Language, including both gestural and vocal communication; and Personal-Social, including the skills of dressing, toilet training, and other culturally related behaviors. Items are assigned to 4-month chronological age ranges. An infant's performance may be expressed as an overall "MA"/CA developmental quotient (Maturity Age $\div$ Chronological Age $\times$ 100) or in terms of separate performance on any of the four subscales.

The Cattell Infant Intelligence Scale (1940) is essentially an extension downward in age of Stanford-Binet items and proce-

dures; many Gesell items are incorporated. Intelligence Quotient (IQ) scores are obtained by the MA/CA formula: 100 × (Mental Age ÷ Chronological Age).

From England, *Griffiths* (1954) offers a fourth infant assessment device, focusing on locomotor development, personal-social skills, hearing and language, eye-hand coordination, and manual performance. The division of the test into five subscales which can be scored separately provides a profile which may be diagnostically useful.

"Piagetian" tests of infant development

The *Uzgiris-Hunt test* (1966) is the only such test well standardized at this time, although there is a similar test also being developed in France (Casati and Lezine, 1968). As indicated in the introduction, this test emphasizes not just the standard motor and physical development, but the development of purposive behavior, object permanence, and other milestones in early infant development as seen by Piaget. Six series of tasks are included at each of several ages: (1) visual pursuit and permanence of objects; (2) development of means for obtaining desired environmental events; (3) imitation; (4) development of causality; (5) construction of objects in space; and (6) development of schemas for relating to objects.

Of the tests described here for assessing infant functioning, the Bayley is the most widely used currently, not only because it is the best standardized, but also because it is the most recent, and incorporates some of the ideas from Piagetian theory which had been absent from earlier developed tests. The Uzgiris-Hunt test, while promising particularly for research, is still in the early stages of standardization. In addition, the Uzgiris-Hunt test is primarily intended to contribute description or a means of analyzing the character of an infant's cognition. It is an ordinal scale, not an age scale by which one can assign an infant a mental age or compute a developmental quotient.

- Standard quantitative tests of preschool-age and older children

The most widely used test, beginning with children as young as age 2, is the *Stanford-Binet* (see Stott and Ball, 1965). The test contains a different set of items at each age level, with no particular attempt to assess the same domains of behavior at each age. This is based on the assumption that all items relate to the same factor: intelligence. Over several age periods there are likely to be items covering language development, concepts, perceptual-motor integration, perceptual discrimination, classification, etc.

Also common in use with young children is the *Goodenough*

Draw-a-Man test (Goodenough, 1926) which is widely believed to be a more "culture-free" test. The child is scored for the degree of detail provided, in comparison to the normal degree of detail provided by children of the same age. Since all children have had an opportunity to see men, it is presumed that all have had roughly equal access to the information needed to perform the task.

The Wechsler Intelligence Test for Children (1949) has been standardized on children from 5 to 15 years. Separate deviation IQ's may be obtained for scales composed of verbal subtests, performance or minimally verbal subtests, and the overall, full-scale test performance. A newer Wechsler Preschool and Primary Scale of Intelligence has been developed for use with children 4 to 6½ years.

Two additional mental tests used frequently in the preschool years are the *Merrill-Palmer* (1931), which includes a variety of minimal language, as well as language tasks suitable for young preschoolers, and the *Leiter International Performance Scales* (1936 and 1969). The Leiter covers preschool through adult years and was developed for use with deaf persons. It is useful in those situations in which a measure of intellectual functioning exclusive of any language whatsoever is deemed appropriate.

Alternative Measures

In addition to standardized tests, there has been increasing use in recent years of a host of other measures, each tapping a single aspect of the child's functioning, and each hopefully predicting later cognitive development. Perhaps the most important of these are the measures of *attention*, since there are arguments proposed that the development of strategies for deploying attention is at the very heart of cognitive development (Lewis, 1967; Lewis and Goldberg, 1969; Lewis, Goldberg, and Campbell, 1969; Kagan, 1971).

Two quite different aspects of attention have been studied, "attention span" and "rate of habituation." In studies of attention span, the assumption is made that the child who is able to sustain attention on a single task will fare better in learning that task or related tasks than the child who cannot focus attention for any length of time. There is some research support for this assumption (Matheny and Brown, 1971), as well as for the oft-found contention that a child with a poor attention span may be suffering from some neurological damage. Honzik, Hutchings, and Burnip (1965) found, for example, that the neonatal classification of

children as neurologically "suspect" or "not suspect" predicted ratings of attention span at 8 months: those rated as "suspect" during the neonatal period were more likely to show slower growth of attention span, to be more distractible, less well coordinated, and to be less able to solve problems at 8 months than were the "non-suspect" group. We also know that attention span increases with age during the first several months (Bayley, 1969), so that an assessment of attention span in a single infant may tell you something about whether his development is normal or not. Overall, however, while a measurement of attention span may well be predictive of learning ability at a later date, it is more widely (and perhaps more properly) used as a signal of other potential difficulties.

Of more direct interest for the assessment and prediction of mental development are the more recently developed measures of habituation. Habituation refers to a progressive decline in attention with continued presentations of the same stimulus: the first time you hear the wind banging a window frame, you startle; the second time you startle somewhat less. Eventually you stop reacting altogether. The same process occurs in infants as well, although more slowly than in adults.

The ability to habituate is of interest for two reasons. First, without this ability, we would all be at the mercy of the myriad repeating stimuli in our environments; so much of our attention would be devoted to responding to common, familiar items, that we would have nothing left for new learning. So speed of habituation is required if the child is to be able to pass on to new things. Second, the speed with which an individual habituates to a new stimulus may tell us something about the rapidity with which he can extract the necessary and useful information from that stimulus. A child who requires 15 presentations of a stimulus before habituation occurs, compared to a child who requires five, is in some sense slower to learn. So individual differences in rate of habitation among infants may well be good predictors of later mental development.

Lewis, in several papers (Lewis, 1967; Lewis and Goldberg, 1969; Lewis, Goldberg and Campbell, 1969) has suggested something like this. He measures habituation with a rather complex process in which the infant or young child is presented with a repeated visual stimulus; the child's response is measured sometimes by the duration of looking, or the number of looks, and, more commonly, by the degree of heart deceleration at the first presentation, then lesser decelerations until finally there is no sign, from the heart rate, of any further "attention" to the stimu-

lus. Using such a measure, Lewis has shown that rate of habituation at 13 months of age was predictive of later Stanford-Binet IQ's at age 3½, with a correlation of rho=.46 for girls and .50 for boys (1971). He also reports that among 44-month-old preschoolers, greater speed of habituation was associated with superior concurrent performance on concept formation and visual discrimination learning tasks (Lewis, Goldberg, and Campbell, 1969).

These findings certainly suggest the possibility that measures of speed of habituation during infancy or early childhood may be good predictors of later mental development, perhaps because they are related to rate of maturation, or possibly also because they are related to the degree of stimulation provided for the child in the environment. There is support for both possibilities. McCall (1971) reports a Russian study by Polikania and Probatova (1958) which demonstrated that premature infants do not habituate as readily as do full-term infants, and we know that there is a steady increase in the rate of habituation with age during the early months. Both of these findings suggest a close association between habituation rates and maturation. But Lewis and Goldberg (1969) also have evidence suggesting a relationship between rate of habituation and the amount of social stimulation provided by mothers: the more stimulated infants (3-month-olds in this instance) habituated fastest. These results are provocative and promising, but more information from other researchers is clearly needed.

Another domain of behavior which is sometimes studied with an eye toward predicting later mental development is the child's activity rate. There have been some suggestions that hyperactive children, in particular, may have a poorer prognosis for later intellectual functioning. Only scant evidence is available to support this suggestion. Battle and Lacey (1972) found that for boys, hyperactivity was a fairly stable characteristic through the ages 0-10 years, and that it did predict lessened interest in intellectual achievement during the preschool periods. But for girls, hyperactivity was neither a stable personal characteristic nor predictive of lessened intellectual striving—the reverse in fact. Hyperactive girls were *more* achievement-oriented than their less active peers. These findings, along with other earlier research, suggest that measures of activity level, while of interest possibly as predictors of neurological dysfunction, of social consequences (Battle and Lacey, 1972), or possibly of emotional distress, are not likely to be good predictors of later mental functioning.

Factors Influencing Mental Development

Using the measurement procedures described above, what has been discovered about the factors influencing mental development? Which children are the more rapid developers, which children the slowest? Is it physical, or environmental, or some interacting combination of the two?

Physical Determinants

Heredity: It is clear from all the extensive analyses and discussions of this complex problem that some substantial portion of the variability among individuals in performance on mental tests is accounted for by hereditary differences. The estimates of the proportion of the variance attributable to heredity differ from the 80 percent suggested by Jensen (1969) to the 40 percent suggested by Jencks (1972), but there is good agreement that the impact of heredity, at least on those skills measured by standardized tests, is considerable (Bayley, 1970, p. 1186 for a good short discussion; Burt, 1966; Freedman and Keller, 1963; Hunt, 1961).

Physical status at birth: There are several longitudinal studies, in which infants who are at high risk at birth have been followed through the early years, and whose later mental development has been assessed at various ages. In virtually all of these studies, the general finding is that children who were most at high risk at birth, either because of complications of the pregnancy or during the birth process, are likely to perform poorly on later measures of cognitive functioning. For example, Smith, Flick, Ferriss, and Sellmann (1972) report that among a sample of 301 black infants, the following variables assessed at birth were predictive of later cognitive retardation: weeks of gestation, maternal age, normalcy of labor, diseases of pregnancy, infections during the second and third trimester, age at first breath, age at first cry, birth weight, 5-minute Apgar, and highest bilirubin.

In addition, they found that maternal IQ and maternal education also predicted later cognitive functioning of the child, which complicates the picture somewhat, since maternal education is also correlated with such factors as the earliness of obtaining and adequacy of prenatal care. Other investigators have found the same early physical status variables to be good predictors of later intellectual outcomes. In particular, prematurity (Drillien, 1964; Knobloch, and Pasamanick, 1959, 1960), neonatal anoxia (Apgar, Girdany, McIntosh, and Taylor, 1955) and infant neurological status (Ireton, Thwing, and Gravem, 1970) have all been emphasized as important predictors of later cognitive development.

However, as has already been emphasized in the chapter on prenatal and perinatal factors, the child's physical status at birth, and during the early years, is not as good a predictor of later mental development as one might suppose, for the simple reason that the effect of physical status is heavily mediated by the characteristics of the environment in which the child grows up. Drillien (1964) reports that prematures are *not* retarded in mental functioning at age 5 if they have grown up in a middle-class family, while prematures growing up in a lower class family are likely to show retarded mental functioning at age 5. Willerman and Broman (1970) have reported that infants who are measured as slow in intellectual functioning during the first year are likely to continue to show slower mental development only if they are reared in a lower social class family; those with the same infant test scores who are reared in middle-class families are not likely to continue to show difficulties. Ireton, Thwing, and Gravem (1970) found that 4-year-old IQ scores were best predicted by the social class of the family, next best by the infant mental score, and least well by the child's neurological status at 1 year.

All of these findings suggest that while physical status at birth is an important variable to consider, more must be known about the environment in which the child is reared before infant status becomes a very helpful predictor of later mental development.

Nutritional status: An entire chapter in this volume has been devoted to this topic, so no extensive discussion is required here. Suffice it to say that there is increasingly good evidence that the nutritional adequacy of the mother's diet during pregnancy, and the infant's diet during the early months of life, are important predictors not only of concurrent intellectual functioning but also of long-term intellectual potential.

Environmental Determinants

Parental education and social class: Much has been made, in the paragraphs above, of the usefulness of both education and social class as predictors of the child's intellectual status. The correlations between education and socioeconomic status and the child's measured performance, however, do not emerge strongly until the child is between 2 and 3 years of age (Golden, Birns, Bridger, and Moss, 1971). In general, infant tests of mental development do not correlate highly with either parental education or social class, while in older children the correlations are marked.

There are several difficulties here. First, parental education and social class are presumably in part a function of the parents'

own genetic endowment; so measures of either education or social class are confounded with heredity. Second, even if we disregard the confounding of genetic influence, there is no serious suggestion that education or social class per se have an impact on the child. Presumably, parents with more education or from a higher social class behave differently toward their children or provide a different kind of environment. We are only beginning to understand what some of these behavioral differences are (see the chapters on environmental influences in this volume). Third, the fact that the infant mental tests do not correlate with social class or parental education poses some difficulties. Is it that the impact of those variables associated with social class are simply not felt until later? Is the effect cumulative? Or do the differences in parental behavior simply make no difference in the infant, but only in the older child? The study cited previously by Wachs, Uzgiris, and Hunt (1971) which uses the Uzgiris and Hunt assessment of infant mental development, does show some relationship between parental behavior and the infant's mental functioning at 8 months. And Yarrow, Rubenstein, Pedersen, and Jankowski (1972) found correlations between a mother's behavior with her 5-month-old infant and the infant's concurrent performance on the Bayley scales. So we have some reason to suppose that differences in parental behavior have an effect on the development of intellectual or pre-intellectual skills in the infant, but we are a long way from being able to tie those differences in early treatment to later differences in intellectual performance.

General environmental impoverishment: There is extensive evidence from studies of institutionalized infants that the very general impoverishment, both of interpersonal relationships and stimulus experience encountered in many institutions, has a generally debilitating effect on the child's intellectual development (Spitz, 1945; Goldfarb, 1945, 1955; Bowlby, 1952; Provence and Lipton, 1962; Dennis and Najarian, 1957; Dennis, 1960). What all of this tells us is that at the extremely impoverished end of the continuum of environmental impoverishment/enrichment one can locate environments which seem to have a very general debilitating effect. But this research does not tell us whether milder forms of the same kinds of impoverishment will have similar though milder effects on the child's intellectual or emotional development.

Effect of schooling: One of the earliest controversies about the impact of environment on intellectual development centered on the question of the impact of schooling on that development. During the 1930's, there was extensive research on this question

at Iowa University (Wellman, 1932; Skeels, Updegraff, Wellman, and Williams, 1938). The Iowa studies seemed to show that children who had been in a part-time nursery school had higher scores on IQ tests than children who had not been in such a school, with the effect particularly notable when the children had come from an impoverished environment (such as an institution) to begin with. After extensive argument in the literature about this series of studies, the whole question seemed to die down for 30 years. But in the 1960's the issue was reopened with the advent of the first "compensatory education" programs, in which children from poverty level backgrounds were given preschool experience in an effort to provide the experiences and skills needed to perform adequately in school (Deutsch, 1969; Weikart, 1972; Klaus and Gray, 1968; Gray and Klaus, 1970).

The fact that virtually all educational programs of this type begin when the children are 3 and 4 years old must be considered in interpreting the results of these programs. The findings tell us that a small intervention at this age makes only a small difference later. What we do not know is whether a small intervention earlier would make a bigger difference, or whether more intensive intervention at any time would have a larger effect. The findings of Willerman and Broman (1970), as reported earlier, showed that children with low infant test scores have poorer prognosis if raised in a lower class family, suggest at least the possibility that differences in environment during infancy, if considerable, may have a major effect on the child's cognitive development over the long run. Also there is now some evidence from several studies of children who took part in experimental day care programs from the first year of life that such early "intervention" may produce very large effects on measured cognitive functioning, although we do not know how long those differences will persist (Robinson and Robinson, 1971; Caldwell, Wright, Honig, and Tannenbaum, 1970).

Obviously the conclusion to be drawn from this very brief overview of evidence on the impact of environment on mental development is that we simply do not know enough. It seems clear that some aspects of the child's environment are crucial, but we are a long way from being able to specify what precise environmental events are important or their precise effects on the child.

The Problem of Prediction

Thus far we have touched briefly on some of the definitions of mental development, the assessment procedures which have grown out of those definitions, and some of the findings suggesting

environmental and physical influences on mental development. Throughout, we have discussed these questions as if there were a clear continuous development of mental abilities from birth through childhood. Obviously Piaget assumes such a continuum of growth, with each stage building upon those that preceded it in a smooth progression. The developers of the various infant tests of mental development also assumed that it would be possible to assess some of the same dimensions of mental functioning in infants as had been assessed in the earlier-developed tests of older children. They too assumed that there was a continuum of growth: a child who acquired increments of knowledge and skill rapidly during the first year of life should be the same child who acquired increments of skill and knowledge rapidly at age 3, or age 5, or age 10.

Unfortunately, this seems not to be the case. The quite definite conclusion from the now numerous studies of infant and preschool IQ scores is that these scores up to approximately age 2 do not correlate highly with later scores. Put another way, you cannot confidently predict later intellectual status from knowing a child's relative developmental status when he is 1 year old. Bayley's results from her own tests are illustrative: she found a correlation between the 4-year-old IQ's and infant scores taken at age 1 month to 3 months of –.21; between 4-year-old IQ's and 4- to 6-month scores of –.16; between 4-year-old IQ's and 8-month scores of .02; and between 4-year-old IQ's and 11-month scores of .27. By 21 months the correlation was .49 (Bayley, 1970). It has been pointed out (Thomas, 1970) that prediction improves with the degree of deficiency. While on the one hand one may have confidence that very low developmental test scores bear a satisfactory relationship to low mental test scores at later ages, it is also possible that the prediction could be made without going to the trouble of administering a developmental test.

Obviously a lack of high correlations between "infant IQ's," as measured by any of the standard infant tests, and later mental development greatly complicates the problem of early prediction. If one is trying to identify, during the first year or so, those children who are likely to have difficulties later in school, or in other related pursuits, it would be extremely helpful if there were an infant test that correlated highly with later mental test scores. At the moment, no test meets those criteria, for any one of several reasons.

It has been frequently pointed out that the infant tests, at least the standard ones, simply do not measure the same sort of behaviors as do the later tests of mental development. The tests

on older children—starting at about age 2—are heavily verbal, while the infant tests are not. The infant tests measure mostly perceptual and motor development, and neither of these domains is heavily represented in the items on the tests for older children. So possibly there is no correlation simply because we are measuring apples on one occasion and oranges on the other. If this logic is correct, then if one could find some way of assessing oranges at an earlier age, prediction would be improved.

In some respects the Uzgiris-Hunt test, and other infant tests based on Piagetian theory, are designed to do this. The items on the Uzgiris-Hunt test are selected on the basis of Piaget's observations of the sequence of early cognitive development. They do not assess perceptual and motor development, per se, but rather the child's use of motor and perceptual skills in the service of problem solving of various sorts. As the Uzgiris-Hunt scales are extended upward, we may discover that infant measures on their tests are more highly correlated with later measures on the same tests than is the case for the more standard IQ tests. Should this turn out to be the case, then we would have the infant predictor needed for early identification of potential problem children.

But it is also possible that there is no infant test that will ever be a very good predictor of later mental status, for either of several reasons. First, it is entirely possible that what we normally consider as "thinking" does not occur in a child until about 18 months or 2 years; and Piaget, as well as others, has emphasized the importance of a shift from "perceptual-motor" functioning to "pre-operational" functioning at about this time, with the shift marked by the child's newly developed ability to represent things internally. There may thus be a genuine discontinuity at about this age, with quite different forces affecting the rate of development during the sensory-motor development phase than during the later periods. Alternatively, it is quite likely that the relative importance of physical and environmental factors shifts somewhere around age 2. During the first 2 years the child's rate of development is much more heavily influenced by his initial physical status. For example, at 8 months or 1 year, one can still identify prematures in comparison to full-term infants; by age 5 the difference is much less marked. At the same time, we know that the level of education of the mother is a good predictor of mental development of the child after age 2, but not a very good predictor before that time. This combination of findings suggest the possibility that the child's physical condition may be of greater influence on infant test scores, but that the environmental influences are more crucial in the long run. If this reasoning is correct, then

there should be some subgroups of children for whom good predictability could be obtained from infant to later test scores. The child in poor physical condition or slow to maturate during the early years who is also in a home with a mother of lower education, should be more consistently low in test score than the slow-maturing child who is reared in the high education home. And that is exactly what Willerman and Broman (1970) found.

We thus come back to the point emphasized in the introduction to this monograph: it is time we stopped thinking about single predictors of outcome variables. If we take mental development at age 4 or 5 as an outcome, we must consider more than just the child's rate of mental development in infancy as a predictor. We must simultaneously look at the nature of the environment in which he is growing up, his physical health, and a host of other factors. The other moral to be taken from the predictor problem discussed here is that any study in which prediction of mental growth is one of the aims must follow the children well past the first year of life. Prediction of 1-year mental growth status may have important benefits in and of themselves, but long-term status may be quite different. And we need to understand both.

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Chapter 12

Social Development

Of the many outcome variables discussed in this monograph, social development, often paired with emotional development, is probably the one we know least about in terms of what is considered either "normal" or even generally desirable. As Starr (1972) points out, social-emotional development differs from other dimensions of development in that there are probably both upper and lower limits to the optimal range of expression: children may be considered too assertive, too attached, too fearful, or even too "good." In contrast, a child is unlikely to be considered too intelligent or to have too good a command of language. However, once one begins making assertions about how much of what is a good thing, one leaves science behind and ventures into the quagmire of value judgments dependent upon one's own cultural frame of reference. The ways people interact with each other are probably more dependent on the socialization process and hence on cultural variation than is any other behavior (Flapan and Neubauer, 1971). In other words, social styles that may be highly effective in one milieu may be ignored or even ridiculed in another. A review of the debate on how to assess social development is presented in the papers of the 1972 Boston Conference on Screening and Assessment of the Young Child at Developmental Risk, sponsored by the President's Committee on Mental Retardation (Meier, 1972).

One way of circumventing the problems involved in making value judgments about the development of a particular social skill is to clarify what kinds of behaviors one means by "social" and to set about relating these behaviors to other characteristics of the individual or his environment. Defining the term "social" is critical for any discussion of social development, since the term elicits such diverse associations as emotional illness and psychopathology, personality and temperament, "phases" of negativism or shyness, acculturation, and the presence or absence of such socially approved, personal-care skills as using a spoon. For purposes of this review, we shall define as social a broad range of behaviors, including those an infant brings into his or her world that may be expected to affect how others respond to him, as well

197

as those behaviors which appear to be dependent on specifiable behaviors in others. We consider "emotional behavior" only within the broader context of social behavior: only those emotional behaviors which can also be described as social are included, such as crying or displaying fearfulness in the presence of a stranger. Although the arousal of emotions and manner of expressing them are closely related to experiences with people, we realize that there are distinctions between emotional and social behavior: not every emotional response is evoked by a social stimulus, and not all social behavior is associated with an emotional response (Ricciuti, 1968). Contemporary research in infant development, however, tends not to isolate either emotional, social, perceptual, cognitive, or learning processes from one another, in recognition that none of these processes develops or appears independently in the young child (Ricciuti, 1968).

Research

The early literature on infant social development comes from two diverse traditions, but both foster the practice of making judgments about "normality" and "desirability." One tradition, popular in the 1920's and 1930's, involved the detailed collection of normative data concerning the age of appearance of various social and emotional behaviors (Ricciuti, 1968; Kessen, Haith and Salapatek, 1970). While the behavioral descriptions offered by these studies are often excellent, the sampling is limited and cannot be considered adequate for the 1970's. Few implications can be drawn from an individual's deviation from these norms. Additionally, information about the frequency of certain behaviors at certain ages is probably not a sufficient basis today for understanding infant behavior. The second tradition, applying psychodynamic theories, relates atypical social responses to pathogenic parenting. Studies such as those which focus on extremely deviant behavior or environments are excluded from this review. For a critique of the potential of a traditional psychodynamic approach for expanding knowledge about infant social development, the reader is referred to Chess, Thomas, Birch, and Hertzig, 1960; and Yarrow and Goodwin, 1965.

Current work on the social development and behavior of infants may be grouped in two broad categories: studies focused on how infant behavior is affected by various kinds of socially mediated inputs, and studies centered on the relatively stable individual characteristics of the infant which presumably affect the way others relate to him or her. It is clear that a single infant behavior, such as crying or smiling, may be studied by some as

dependent on people's response to the infant, while treated by others as a characteristic which the infant brings into a social situation and which has a powerful effect on his environment. These approaches point up the essentially interactive character of social development. Furthermore, a single behavior such as smiling may be either socially dependent or socially independent, according to the infant's age. Rheingold (1966) discusses changes in the smiling response: the primary role of people as elicitors of the response in very early infancy, the subsequently greater smile-evoking power of inanimate objects, and finally the return of social stimuli as effective in eliciting smiles, due in large part to instrumental conditioning.

Effect of Infant Behavior on Social Environment

A number of studies have attempted to demonstrate individual differences and stability in selected behaviors without, in some cases, explicitly trying to relate these behaviors systematically to any social consequence. Such studies have examined the tendency of neonates to respond to various kinds of stimuli (Birns, 1965), individual differences among infants in their response to soothing (Bridger and Birns, 1968), individual differences in activity level (Thomas, Birch, Chess, Hertzig, Korn, 1963), and differences in response to a fear-provoking situation (Maccoby and Jacklin, 1973). One characteristic in which infants differ markedly is behavioral variability itself. Richards (1971) discusses the effects of infant variability on maternal behaviors and points out that the mother of an unpredictable infant has difficulty timing her behavior appropriately. This might be expected to greatly complicate the business of mothering.

Perhaps the best-known studies of stable individual differences among infants and their contribution to parent-infant interactions are those of Thomas, Chess, Birch, and Hertzig (1960). This group has identified nine categories of behaviors or characteristics that are relatively consistent during the first 2 years: activity level, rhythmicity or predictability, approach or withdrawal from new stimuli, adaptability to new or altered situations, intensity of reaction or energy of response, response threshold, quality of mood, distractibility from ongoing behavior, and attention span or persistence in the face of obstacles. An infant's "reactivity" pattern is composed of these nine elements. Various clusters of behaviors are discernible; for example, the "difficult" child exhibits irregularity, withdrawal from new situations, nonadaptability, intense responses, negative mood, and nondistractibility from ongoing behavior. This child's effect on his immediate social

environment may well differ markedly from that of a child displaying medium activity, regularity, adaptiveness, approach tendencies to new situations, mild intensity of response, positive mood, distractibility from ongoing behavior, and persistence (Chess, et al., 1960; Chess, 1967).

A similar approach is taken by Kagan, who conceptualizes infant personality as comprising those unique or different behaviors that set an individual apart from others (1971). The differentiating innate characteristics include irritability threshold, vigor of activity, and threshold of attention (Kagan, 1966). Sears (1966) argues convincingly for the inclusion of biologically based "personality" characteristics within a social framework, maintaining that after the neonatal period all the characteristics labeled as "personality" have social elements.

Effect of the Social Environment on Infant Behavior

A second group of studies attempts to find out whether there are any stable differences among the behaviors of mothers or other caretakers which can be related systematically to differences in infant behavior. In this approach, the infant's characteristics are considered the dependent variable, influenced by parenting practices and attitudes and various kinds of stimulation. The infant behaviors are considered "social" because of the social character of the independent variable, even though the infant responses are often minimally social. This concept of social characteristics supports Rheingold's definition of social behavior as that which is evoked, maintained, and modified by the presence or behavior of another (1966). Although the potential range of social behaviors thus defined is huge, review of the literature suggests that a fairly restricted assortment of infant behaviors has actually been studied.

Mental development: One behavior against which to measure the effects of social input is the infant's performance on tests which yield a developmental or intelligence quotient. The IQ is undoubtedly attractive as a readily obtainable measure of infant behavior, but it may have advantages other than convenience. For example, after a thorough study of interrelationships among a variety of infant and maternal behaviors, Beckwith (1972) suggests that the quality of mother-child interactions may affect intellectual functioning and frequency of vocalizations more readily than social behavior. In a separate report (1971) Beckwith demonstrates a relationship between infant IQ and a variety of social inputs from the mother, including how much she touches and speaks to the infant, how often she gives the child opportuni-

ties to explore, and how often she provides social experiences with other people. The developmental quotient was also used as a dependent infant variable in the Scarr-Salapatek and Williams study of the effects of a home stimulation program (1973). One of their secondary findings was that higher developmental quotients are associated with situations in which the mother lives alone and plays often with the infant as compared to more crowded situations, or those in which the infant has less of the mother's time and attention. Yarrow and Goodwin (1965) identified a number of maternal stimulation variables and found a systematic relationship between certain kinds of stimulation and infant IQ. Schaffer (1965) investigated the effects of maternal separation due to infant hospitalization, using changes in developmental quotient as a dependent variable, and reports a significant difference in IQ changes depending on whether the infants were in a highly stimulating, amply staffed hospital or one with a minimal amount and variety of social stimulation. Additional discussion of the relationship between social stimulation and infant mental development is in the chapter on mental development.

Attachment: Considerable attention has been given to the effects of different kinds of mothering on attachment behaviors of the infant. A variety of infant actions may be identified as attachment behaviors. These actions are partly determined by the maturity of the infant (Ainsworth, 1963) and may have little stability over time (Coates, 1972b). Attachment itself, however, appears to emerge as a full-blown condition (Coates, 1972a). Ainsworth finds a relationship between "secure" attachment (defined according to the infant's use of the mother as a base from which to venture and explore and the infant's freedom to expand his interpersonal relationship) and such maternal behaviors as her excellence as an informant, her interest in details of her child's actions and development, and the amount of time she spends with the infant (not necessarily her "availability" in the household). The effects of relatively long-term separation, due to prematurity, on early infant attachment behaviors and on maternal behavior as well have been explored by Leifer, Leiderman, Barnett, and Williams (1972), who conclude that such separation may have a greater initial effect on maternal behavior than on infant behavior. Attachment may also be viewed as a developmental process in which the infant's attachment behaviors have a pronounced effect on his parents, especially as he seeks to promote proximity (Ainsworth and Bell, 1970; Wahler, 1967).

Response to stress-provoking situations: The infant's reaction to stress is yet another behavior or cluster of behaviors which

have been viewed as dependent on certain kinds of caretaking or mothering. The presence of strangers is one form of stress frequently studied. Moss, Robson, and Pederson (1969) relate reaction to strangers, as measured by ratings of fear to the degree to which the infant looked at the stranger's face, to maternal education and early stimulation of distance receptors (as opposed to tactile physical stimulation). They report also that less educated mothers and mothers of infant sons provided more physical stimulation, while better educated mothers and mothers of daughters provided more stimuli for the infant to see and hear. Ambrose (1963) explored the relationship between an infant's smiling at strangers and maternal behavior, and found that the level of responsiveness to people other than the mother is related to the level of responsiveness achieved earlier to the mother and generalized to the new person. Ambrose concludes that an infant's anxiety associated with his mother's failure to satisfy needs will transfer to new people, therefore inhibiting approach behavior and smiling. One unfortunate consequence, Ambrose adds, is that the infant who withdraws from strangers will not learn that each person is different and will continue reacting with limited responsiveness and much anxiety. One implication of Ambrose's discussion is that infant responsiveness to both mother and strangers is associated with mother's success in responding appropriately to the infant's needs.

Reaction to a stranger was one of the dependent variables in Beckwith's study (1972) of mother-infant relationships. In contrast with Ambrose's data, Beckwith found that for older infants, aged 8 to 11 months, who were living in middle-class homes affording ample care and social contact, a positive relationship existed between the infant's social play with strangers and *decreased* social stimulation provided by the mothers. Infants whose mothers initiated relatively few contacts were more responsive to the overtures of the stranger, and, among 3-month-olds, responsiveness to the stranger was positively related to maternal restrictiveness. Clearly, one must exercise caution in generalizing about what is apt to provoke fear in infants. Additional studies of response to strangers are reported by Rheingold (1966) and Ricciuti (1968).

Yarrow and Goodwin (1965) relate the infant's ability to cope with stress to a cluster of maternal attitudes and feelings: her emotional involvement, her concept of the infant as an individual, her responsiveness to the infant's attempts to communicate and the degree to which she feels it important to help the child adapt to stimulation which might be stressful. Thomas, Birch, Chess,

and Robbins (1971) relate the infant's reactions to stress and how he adapts to such significant situations as feeding, sleeping, social restraint, and toileting to maternal attitudes as well as to the infant's reactivity.

Crying: Infant crying is another behavior which has been related to maternal responsiveness. Beckwith's study (1972) of 8-to 11-month-olds found that babies who cried more had mothers who ignored them. Bell and Ainsworth (1972) studied frequency and duration of infant crying during the first year, and concluded that crying was inversely related to the consistency and promptness of maternal response. Though it appeared that certain techniques, such as holding the infant closely, were more effective than others in stopping tears, the effectiveness of the technique was not as powerful in reducing crying as promptness of maternal response in the preceding months. Bell and Ainsworth discuss their data in terms of refuting popular notions about "spoiling" infants. They make two important observations: first, later non-crying modes of communication, as well as a decline in crying, are associated with maternal responsiveness to infant signals including crying; and second, infants whose mothers have given them much affectionate holding in the earliest months are content with surprisingly little physical contact by the end of the first year and can move off into independent exploratory play, while infants who have been held briefly do not respond as positively when held later, protest when put down, and do not turn readily to independent activity.

Smiling: Just as crying appears associated with decreased maternal responsiveness in the early months, infant smiling appears associated with increased maternal responsiveness. In his study of infant social responsiveness, Ambrose (1963) reports a delay in the initial appearance of smiling among institution-reared infants as compared to home-reared babies. He further observes that the first peak of smiling among home-reared babies is related to how much the mother reinforces smiling by her characteristic responsiveness to the infant. Rheingold (1966) makes some interesting observations about infant smiling, such as the tendency for infants to smile less at mothers than at fathers. This is due, she suggests, to the consistency of mother's presence plus the fact that her flow of stimuli is not contingent on acts of the infant. In addition, the mother is often disadvantaged in receiving the full measure of infant smiling by the aversive nature of some caretaking activities.

Compliance: The final type of infant behavior to be considered here is compliance with maternal commands and restrictions.

Slayton, Hogan, and Ainsworth (1971) found obedience in 9-to-12-month-olds to be related to the mother's sensitivity to the infant's signals and other behaviors which promote mother-infant harmony, and *not* to the mother's efforts to train the infant. Mothers who gave many commands were also those who intervened frequently in the infant's ongoing activity. Stayton et al., also looked into internalized controls or self-inhibition in their infants and found internalized controls to be related to IQ; to ratings of mother's sensitivity, cooperation, and acceptance; and to the extent to which the infant was permitted freedom on the floor as opposed to playpen restriction. They point out that since obedience, locomotor exploration, and attachment appear at about the same time, it is biologically advantageous from a preservation standpoint for attachment to be accompanied by compliance with maternal signals. In other words, there is a biological disposition toward obedience which exists despite lack of major attempts at discipline. Another observation is that infants comply with verbal commands before they comprehend the semantic content of speech.

Beckwith's study (1972) also casts some light on the relationship between infant compliance and maternal behavior. Infants whose mothers initiated many contacts tended to be more choosy in what they responded to and tended to ignore a larger percentage of maternal overtures than did other infants. Children whose mothers were specifically restrictive or interfering engaged in less social play with them. Of interest is the effect of age on responsiveness to prohibitions: Beckwith's 8-month-olds responded to mother's "No's" with decreased response to her and greater crying, while infants of 10 months responded to "No" as though this were just one more manifestation of mother's tendency to talk with them.

Measurement of Social Development

The most widely used, standardized instruments for assessing social development are those linking the display of adult-encouraged, personal-care skills to an age chronology. Sometimes the "social" tests also include behaviors which might be considered communicative and cognitive, even though in practice an individual's social development score may be contrasted with his scores on language and mental tests.

Vineland Social Maturity Scale (Doll, 1965): This instrument uses an interview format to obtain information regarding an individual's ability to manage his practical needs and take responsibility for himself. The scale includes items pertaining to self-help, self-direction, communication, locomotion, and socialization,

and has been standardized on a sample ranging in age from birth to 30 years. It is most often used with young children or mentally retarded adults whose ability to live without close supervision is being assessed (Anastasi, 1954).

Gesell Developmental Schedules (Gesell, 1949): The test items of the Gesell are grouped into four categories, each representing a major area of development: motor, adaptive, language, and personal-social behavior. The items in the personal-social category are said to cover "the child's personal reactions to the social culture in which he lives" (Gesell and Amatruda, 1947, p. 6). Behaviors included in the category include feeding, toileting, smiling, responses to a mirror, and play.

Denver Developmental Screening Test (Frankenburg and Dodds, 1967): This also categorizes behavior into four major areas: gross motor, fine motor-adaptive, language, and personal-social. The personal-social section of the test contains many items similar to those found on the Gesell, such as feeding self crackers, playing ball, and drinking from a cup. As the DDST is a screening instrument, the assortment of items is more restricted than that of the Gesell.

Developmental Profile (Alpern and Boll, 1972): This is a screening instrument in which the infant or child is given a developmental age on five areas of functioning, based on information reported by parents or others familiar with the child. The authors have grouped items into categories identified as physical, self-help, social, academic, and communication. The self-help section is reported to measure "children's abilities to cope independently with the environment, and measures the child's skills with such socializing tasks as eating, dressing, and working" (Alpern and Boll, 1972, p. 1). Items include, for example, whether a child can go about the house without needing to be constantly watched, or whether he can remove his sox or shoes without help. The social section is reported to measure "the child's interpersonal relationship abilities. The child's emotional needs for people, as well as his manner in relating to friends, relatives, and various adults exemplify the skills which measure the child's functioning in the social situation" (Alpern and Boll, 1972, p. 1).

Two additional assessment tools should be included, although neither are specifically designated as tests of social development. The first is the *Infant Behavior Record*, which is part of the *Bayley Scales of Infant Development* (Bayley, 1969). The Infant Behavior Record holds promise as a useful means of collecting information about social behavior. It consists of a number of descriptive rating scales of such behaviors as cooperation, emo-

tional tone, fearfulness, goal directedness, attention span, endurance, reactivity, responsiveness to people, and interest in different kinds of stimulation-producing activities. Although the scales are useful in themselves as a means of evaluating and recording impressions of a variety of infant behaviors and characteristics, they are also accompanied by normative data indicating the frequency of different ratings of infants through 30 months of age. Thus one can determine whether an individual rating for "cooperation," for example, is common or uncommon for a particular age. There is no empirical justification, of course, for considering a certain rating necessarily good or bad. Another approach to the evaluation of social development is the *Ordinal Scales of Infant Psychological Development* (Uzgiris and Hunt, 1966), particularly the Scale of Vocal and Gestural Imitation. The degree to which an infant imitates important adults in his environment, as well as the maturity of his imitation, may well be related to the encouragement and delight such imitation receives. The research of Wachs, Uzgiris, and Hunt (1971) supports this hypothesis. Conversely, the infant who readily mimics what he views in others is thereby providing important social feedback, which influences others' reactions to him.

The most useful social outcome variables at the early time point of 1 year of age are undoubtedly those which have the greatest probable bearing on the way the child will affect his social environment as he grows older. While social behavior at 12 months is of course affected by the infant's history of social learning, his social development at that point is obviously not an end in itself. Evaluation of a variety of characteristics, such as those included in the Infant Behavior Record (Bayley, 1969), may be most useful in predicting future behavior and is supported by current research involving social behavior in infancy.

Summary

The current scientific literature pertaining to infant social development seems to be at its best in describing the increasingly refined analyses of a limited number of phenomena, such as the infant's response to strangers. On the other hand, empirically demonstrated relationships between the enormously varied stimuli present in infants' social environments and the similarly varied characteristics of infants are a long way down the road. Equally distant is a body of data relating infant characteristics to behaviors observed in childhood and adult social functioning. Notions about deviance and desirability, especially as applied to long-range prediction, are premature.

There is an abundance of popularly-known "facts" about which particular maternal activities "cause" certain qualities—usually undesirable—in infants. The data, however, is consistently elusive. The most useful course at present may be to continue to identify the behavioral characteristics in which infants vary and to embark on systematically relating specific contemporaneous social inputs to those characteristics.

While this process goes on, and the gaps are filled slowly, we must make decisions based on the best knowledge available. Defining and assessing social development are fraught with risk, as we have noted, because it is so closely tied to other outcomes and because it is difficult to arrive at unbiased conclusions about "good" or "healthy" social functioning. Nevertheless, if we are to construct a screening method that will locate and eventually provide help for potentially unhealthy children, we cannot avoid making some judgments about optimum social development and about which infant behaviors best predict future difficulties. Our conclusion is that the most critical behaviors are those whereby the individual can affect his social environment. The infant who possesses a limited repertoire of communication signals or social responses, or who does not have varied and systematic means of affecting or progressively changing his environment, is considered particularly disadvantaged.

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208

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